THE

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THE

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THE PASSING OF THE STEAM HORSE.

THE extreme interest attaching to the important subject of electric railway working justifies us in making a few remarks anent the paper read by Mr. Langdon before the Institution of Electrical Engineers, a reprint of which is concluded in this issue.

To our mind, the paper does not appear to have been put forward as a serious attempt to work out the complete solution of a practical case in detail, but rather as a first approximation, calculated to give rise to a highly instructive discussion, and to afford a foundation upon which a more elaborate and more practical scheme can be based.

It cannot be supposed, for example, that a pressure of 600 volts will ever be adopted for the electrical operation of an important main line, and it is questionable whether a length of 50 miles would give a sufficiently steady load to enable a satisfactory economy of working to be obtained. Unfortunately, however, many of those who took part in the discussion gravely accepted the system as not only practicable, but reasonable, and proceeded to discuss the details accordingly.

No doubt, as was stated in the discussion by Mr. Hudleston and others, and as appears from investigations which we have made, the tractive power arrived at by Mr. Langdon was much too low, and the saving in coal claimed for the electrical system must be largely discounted. On the other hand, as Mr. Lawson showed, the efficiency of transmission was needlessly underestimated, and the introduction of rotary converters further cuts down the efficiency. The effect of a low load factor upon the coal consumption was also referred to. But it must be borne in mind that a main line of railway is altogether different from an urban or suburban line, and still more from a street tramway; instead of eight or ten stops per mile, as in the last case, or two or three, as in the first, the stops will generally occur only at intervals of five or six miles, and in many cases, of 50 or 100 miles. Moreover, as the frequency of stoppage is diminished, so also does the probability of more than one or two trains starting together become more remote. The greater the length of line supplied from any one station, the greater is the average load, and the less the variation due to starting and to mounting gradients. In fine, we cannot but believe that on a practical scale the load factor of the running plant will reach a very high value, so that the mean load need not be far below the most economical output of the running plant, and that the load factor of the whole station over the 24 hours can by good management be kept at a high figure.

From an impartial standpoint it seems certain that the three-phase system of transmission is a *sine quâ non* for this class of work, in which the cost of the electrical line is so important a consideration; it is equally certain that substations requiring skilled attendants are inadmissible, and we are forced to the conclusion, to which other considera-

tions also lead us, that three-phase motors on the trains themselves are the only possible kind to satisfy the conditions. The series-parallel system, the great bulwark of direct current traction, loses all its advantages when the stops are few and the speed constant between stations. Large polyphase motors are fully capable of meeting all possible demands upon them as regards starting torque, efficiency, and reliability, their only real drawback being their low power factor; even this is not a serious fault when powers of 100 H.P. and upwards are in question.

An important point, to which Mr. Campbell Swinton drew attention, is the desirability of supplying as great a length of line as possible from a single power station. This ought to be regarded, we think, especially from two points of view—the maintenance of a high mean load, so as to be as far as possible independent of local disturbance of traffic; and the necessity of securing the greatest possible reliability of service. These considerations are mutually opposed; for it is obvious that the more the supply is concentrated in one station, the more serious would be the results of a breakdown either there or in the electrical line. Reliability can to some extent be obtained by operating the power stations in parallel on the high pressure lines, so that every point is fed from at least two separate sources, and by duplicating the feeders; unfortunately it is out of the question to employ underground cables, so that entire reliance must be placed on a well-designed overhead line.

As regards the system of distribution to the trains, it seems to us to be highly probable that public opinion, as represented by Parliament, will never sanction the use of contact rails for pressures much above 500 volts, and we shall consequently be compelled to employ overhead contact wires. This, however, is not altogether a disadvantage, and it is possible that by removing the active conductors entirely from the plane of the running rails it will really simplify the question of crossings and sidings.

A most important contribution to the discussion was that of Mr. Frank Sprague, who pointed out that an electrical line must be organised on a basis totally distinct from that of a steam line. In the latter case it has been found necessary for economical working to run long and heavy trains at considerable intervals, while the genius of electricity is entirely in favour of smaller units at short intervals. As a nation, we are so bound by precedent that we are apt to attach far too great a value to "things as they are,"—witness the slow evolution of a modern corridor railway car from the old-fashioned "coach," by which title, in fact, it is still called by railway men. We must break away from current methods, and consider the requirements of the newer motive agency; and in this connection the possible *abolition*—not merely the supersession—of the locomotive must be taken into account. This will at the same time lead to other radical changes, and to economies of a totally different nature to those already considered. Wear and tear of permanent way; reduced cost of bridges; a far more frequent service, with the consequent saving of time and better division of labour at the stations—many such factors at once come into view when the adoption of a distributed-motor or "multiple-unit" system is debated.

It appears to us that while Mr. Langdon's most timely paper gives a good start to the subject, there is abundant scope for other papers in which the above, and similar points, may be exhaustively dealt with, and a really definite and complete solution threshed out.

American Commerce and Manufacture.—Our American rivals are making great headway in both their imports and exports. This is very pointedly shown in a table which we reproduce below from the New York *Electrical World*. Nearly one-half of the importations are now for their use, and more than one-third of the exportations are their products. Their importations during the nine months ending with September, 1900, amounted to $281,000,000, a daily average of over a million dollars, while their exports of finished goods in the same time amounted to $338,000,000, a daily average of more than a million and a quarter dollars. Never before in the history of the country have the manufacturers figured so well in both directions. During the four years shown in the table, they have increased their importation of materials for use in manufacturing more than 50 per cent., and increased their exportation of finished manufactures more than 80 per cent. The table shows the importations of manufacturers' materials, and the exportations of manufactured goods in nine months ending with September in each year from 1886 to 1900:—

Nine months ending Sept. 30th—	Manufacturers' materials imported.	Manufactured goods exported.
1886	$175,889,544	$101,625,414
1887	190,834,580	98,101,603
1888	175,784,865	99,842,972
1889	198,221,116	111,115,263
1890	208,853,767	113,899,554
1891	225,807,206	126,911,057
1892	219,091,192	111,290,024
1893	224,491,726	129,998,845
1894	169,201,132	133,378,609
1895	238,402,550	145,793,834
1896	183,752,693	184,807,004
1897	200,510,839	212,478,810
1898	193,482,109	227,822,045
1899	242,178,074	277,502,649
1900	281,675,019	338,678,243

Battery Traction in Belgium.—Accumulator traction has received a rather severe check in Ghent (Belgium), an industrial town of 175,000 inhabitants. About a year ago the tramway company decided to adopt electrical traction, disposed of its horses, and replaced them by accumulators, for in view of the fact that the town is composed of 26 islands with 140 bridges, the difficulties of an overhead system were very great, and an underground one was practically out of the question. In view of a very advantageous proposal the concession was granted by the town to a company, or, rather, to two companies (for the concessionaires were so divided); one took in hand the exploitation of the line and the other the station for charging the accumulators. Several municipalities on the Continent have since been awaiting the result. It is regrettable, however, though not a little instructive, to learn that the trial has been a failure. Despite the enormous difficulties in the way, the company now proposes to construct an overhead system save over the "impossible" bridges, when the accumulators will be utilised.

A Search-Light Bâton.—At the big rally of the Republican party at Madison Square Garden, New York City, on Friday night, October 26th, it was proposed to have the vast crowd join in singing "The Star-Spangled Banner," "America," &c., but the great problem was how to lead the mighty chorus. The difficulty was solved by Mr. Chas. J. Bogue, upon a suggestion from Mr. Humphrey, the bandmaster of the Seventh Regiment, N.G.S.N.Y., and musical director of the Madison Square Theatre. Mr. Bogue installed on Madison Square Tower, just below the revolving statue of Diana, and at a height of over 300 feet from the ground, one of his powerful marine projector search-lights, and the beam of this light was used in place of the *bâton* to lead the singing. With a very few lessons Mr. Humphrey caught the knack of handling the search-light, and the beam was flashed up and down, to and fro, with the utmost ease and precision. The results were most effective and startling. The New York *Electrical World*, in mentioning this incident, remarks that it was unquestionably the first time that an open-air concert had been led by an arc light beam instead of a *bâton*.

SOME NOTES ON THE DESIGN OF LARGE ALTERNATORS.*

By A. HEYLAND.

(*Continued from page* 896.)

An inspection of the short-circuit curve of this generator shows that to produce an armature current of 100 amperes per phase, a field current of 18 amperes is necessary. The difference between the two exciting currents is (150 — 18 =) 132 amperes (fig. 4). Such a field current means an

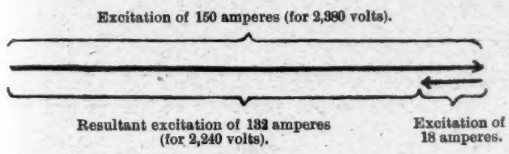


Fig. 4.

induced pressure (fig. 2) of 2,240 volts. The difference, viz., 100 volts, therefore represents the armature leakage. Expressed as a percentage of the terminal pressure (2,240 volts) it is 4·5 per cent. As the armature leakage is proportional to the armature current, the pressure representing it for an armature current of 200 amperes would be 200 volts.

From the data now available, and with the help of the simple vector diagrams of Rothert and the writer,† it is possible to determine the decrease of the magnetic flux cutting the armature conductors, due to the magnetic leakage in the armature, and this will give the fall of pressure of the alternator.

Referring to fig. 5, A, B is the flux at no load, corresponding to the terminal voltage of 2,200; the phase of the voltage E will be, of course, at right angles to A, B. The phase of the current will be given by I, and the phase difference existing between the current and the pressure will be shown by the angle ϕ. For the assumed case under discussion, I is equal to 200 amps., and $\cos\phi$ is assumed to have the value 0·85. To the above-mentioned flux must be added the armature leakage flux B, C (200 volts as determined above), and also a very small flux, C, D, at right angles to I, corresponding to the pressure lost in the armature due to its ohmic resistance, which in this case is 44 volts. The total flux must therefore be A, D (instead of A, B), in order to get the terminal pressure E, and this flux decreases with an increase of the lag angle ϕ. The flux A, D (corresponding to an induced pressure of 2,350 volts per phase) will be seen from the magnetisation curve to require an excitation, A, F, of 145 amperes; add to this an excitation of 36 amperes obtained from the short-circuit curve for the value 200 amperes in the same phase as the load current I, and the resultant excitation, A, G, will be seen to be 168 amperes, corresponding to an induced pressure of 2,500.

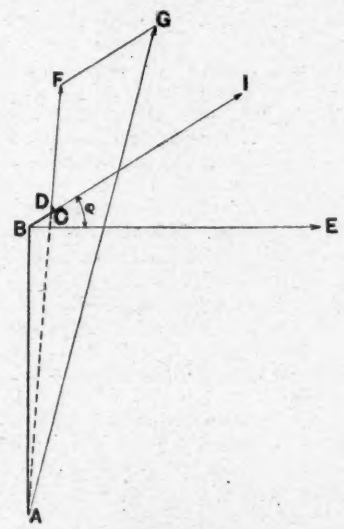


Fig. 5.

It will be seen, therefore, that this particular alternator has a fall of pressure at 200 amperes per phase, and with a power factor of 0·85, of 300 volts per phase, that is to say, 12 per cent. The smallness of this figure is remarkable, and is due in a great measure to the high saturation in the field poles and air-gap; had the points on the magnetisation curve indicating the working pressures of the alternator been on the straight parts of this curve, thus being approximately proportional to the excitation, the fall of pressure would have been 20 per cent. instead of 12 per cent.

Fig. 6 shows the diagram applied to the case of a non-inductive load, the armature current I being in phase with the pressure E. The flux at no load necessary for a terminal pressure of 2,200 volts (under these conditions the terminal pressure is in the same phase as the induced pressure) is represented by the line A, B, representing 2,200 volts to scale; the armature leakage flux, B, C, is represented by 200 volts, and the ohmic drop, C, D (representing the armature flux required for this) is 44 volts, both these quantities being as before; the required exciting current is given by A, F, with the help of the magnetisation curve, and is 132·5 amperes. The field ampere-turns for the reaction of 200 amperes are represented by F, G as an exciting current of 36 amperes, and the resultant excitation, A, G, is thus found to be 141 amperes, corresponding to an induced pressure of 2,315 volts.

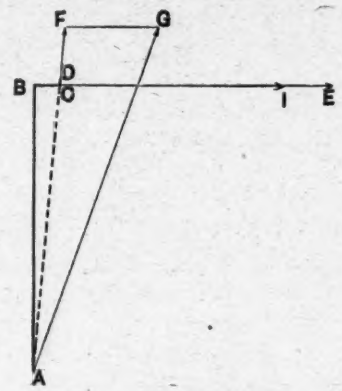


Fig. 6.

The fall of pressure (at constant speed and excitation) with a non-inductive load of 200 amperes per phase is thus found to be 5 per cent.; with a non-saturated field system it would be 8 per cent.

The effect upon the pressure drop of decreasing the air-gap is of special interest with such alternators working with a highly saturated field system. With ordinary machines it is well known that an increase of the air-gap diminishes the fall of pressure, and *vice versâ*, but with alternators designed on the lines under discussion this effect is inconsiderable. Thus, for instance, decreasing the air-gap from 0·315 inch to 0·236 inch displaces the magnetisation curve round an axis, O, fig. 2, it taking up the position indicated by the dotted curve. The form of the vector diagram then changes as shown in fig. 7; here A, B, is the armature flux at no load represented by 2,000 volts, and A, D is the resultant armature flux at full load, that is, 2,350 volts, both these fluxes having the same value as before. Corresponding to the magnetic flux represented by 2,350 volts there is required (see dotted magnetisation curve) an excitation, A, F, of 105 amperes. Adding to this the field current, F, G (36 amperes), the resultant current, A, G, will be seen to be 129 amperes—corresponding to this latter current is an induced pressure of 2,540 volts. That is to say, the fall of pressure has risen to 13·5 per cent., whereas had the poles not been

D

* These notes have special reference to tests made on the alternators of 1,000 E.H.P., exhibited by The Electricité et Hydraulique, Limited, of Charleroi, at the Paris Exhibition.

† Rothert, *E.T.Z.*, 1896, p. 575; Heyland, *E.T.Z.*, 1896, p. 618.

saturated the fall of pressure for the decrease of air-gap in question would have been 30 per cent.

Fig. 8 gives the fall of pressure for the case of the non-inductive load under these conditions, which has risen only to 6 per cent., whereas had the flux densities been of normal value, the fall of pressure would have been 10 per cent.

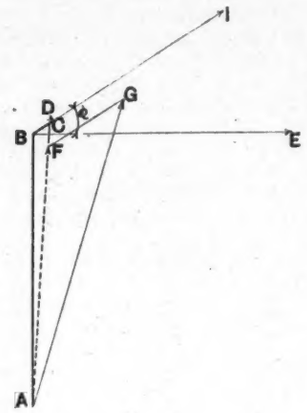


Fig. 7.

The advantage of a saturated field system is thus seen to be of even greater value with diminished air-gap length, or what is the same thing, when a large portion of the excitation is required for the iron circuit alone. Especially is

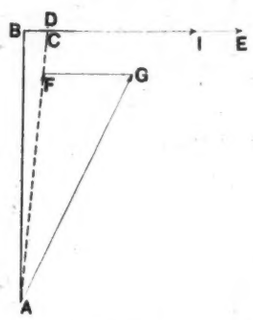


Fig. 8.

this the case with small machines, as the air-gap cannot be reduced beyond certain limits with machines of large diameter.

(To be concluded.)

AN ELECTRIC THEORY OF NERVOUS AND MUSCULAR ACTION.

Several investigators have been struck with the analogies between the behaviour of the so-called coherer when acted upon by electric waves, and the behaviour of the nervous system under the influence of stimulus. Dr. Lodge, in a lecture delivered at the Royal Institution in 1894,* founded on this resemblance an electrical theory of vision. His theory was, that the retina was an electrical organ, maintaining an electromotive force which is prevented from stimulating the nerves by an intervening layer of badly conducting material, or of conducting powder with gaps in it. When light, which is a form of electric radiation, falls upon the retina, these gaps become more or less conducting, and the nerves are stimulated. Branly, the inventor of the coherer in its modern form, has also propounded a coherer theory of nervous action.* Dr. Chunder Bose, by utilising his remarkable discoveries † as to the molecular changes which take place in inorganic substances under the influence of electric radiation, has developed a theory of nervous and muscular action which goes much further than that of any one of his predecessors. A short account of his investigations was given in a paper read at the Bradford meeting of the British Association, which, we understand, is to be followed by a fuller paper to be read before the Royal Society.

When investigating the action of electric radiation upon inorganic substances, preferably in the form of fine particles, Dr. Bose discovered that in some cases their conductivity was increased, in other cases it was reduced. In some substances, this change of conductivity was permanent, in others, the original conductivity was recovered immediately after the electric stimulus was withdrawn. It is the latter class of substances which show, in their behaviour, a remarkable resemblance to the behaviour of nerves and muscles under stimulus.

A good example of a self-recovering inorganic substance is magnetic oxide of iron (Fe_3O_4) slightly warmed. Fig. 1 shows the time changes in conductivity which take place in

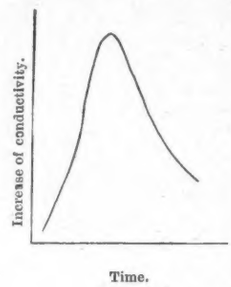


Fig. 1.

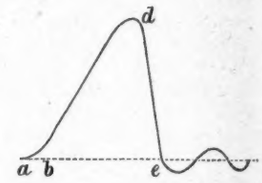


Fig. 2.

this substance when excited by a single electric flash. There is a latent period. The response begins to take place a very short time after the action of the stimulus, and the change continues even after the cessation of the stimulus; after rapidly attaining a maximum, the substance recovers with more or less rapidity. With some substances a tendency to oscillation or after-vibration has been noticed.

Fig. 2 shows the usual curve obtained when a muscle is stimulated; the vertical ordinates representing expansion or contraction of the muscle. It is very similar to the Fe_3O_4 curve, having, in addition, distinct terminal oscillations.

Substances having quick self-recovery like Fe_3O_4 show interesting superposition under the influence of intermittent stimuli. When the intermittence is slow, the curve, fig. 3 (*a*), rises in steps, gradually decreasing in length till the maximum change is reached, after which a horizontal wavy line is maintained till the stimulus ceases, when there is a rapid fall. When the intermittence is rapid, the steps are not visible, fig. 3 (*b*), but the curve has the same general form as (*a*). The curves for muscles under intermittent stimulation are absolutely identical with those for Fe_3O_4 shown in fig. 3.

There is also a remarkable analogy in the effects of temperature on the curve of Fe_3O_4, and the curve of muscular contraction. An increase of temperature up to a certain limit increases the sensibility, and hastens the recovery, but beyond this limit, the sensitiveness and the quickness of recovery are both diminished. There is evidently a temperature of maximum of sensibility for both Fe_3O_4 and for muscle.

The recovery of certain inorganic substances is retarded by the admixture of foreign substances; for example, potassium has a quick self-recovery, but when amalgamated with mercury, the power of self-recovery is lost. Dr. Bose finds in this an analogy to the action of certain poisons, such as *veratria* upon muscle.

The most striking application of Dr. Bose's hypothesis is to the explanation of certain phenomena of vision.

According to the theory at present in vogue among physi-

* Lodge's "Signalling Through Space Without Wires," p. 30.

* Electrical Review, Vol. 42, p. 282.
† Electrical Review, Vol. 47, p. 199.

ologists, vision originates from the metabolic changes produced in the visual substances in the retina; these changes take place in two stages, the constructive or anabolic stage, and the destructive or katabolic stage. The theory is very complex, and several apparently unsuperable difficulties appear to stand in the way of its acceptance. It is difficult, for instance, to see how the rapid visual processes could be due to the comparatively slow chemical action which must be involved in the breaking down of tissue, followed by its regeneration.

According to the electro-molecular theory of Dr. Bose, the visual impulse is an electric impulse; the nerve is a conductor of electric current, and the brain an extremely delicate detector of current. There are two possible ways in which the current in the nerve may be supposed to respond to the varying stimuli of the incident light. (1) The incident light may control the E.M.F. in the nerve circuit, by causing an allotropic change in one of the plates of something corresponding to a galvanic battery. (2) The E.M.F. in the nerve circuit may be constant, and the incident light waves may control the resistance in the same way as electric waves control the resistance of a coherer or molecular receiver.

The latter view is much the same as that adopted by Lodge in his electrical theory of vision, but Lodge failed to explain some curious oscillation phenomena of vision to be described later on, because his erroneous theory of the coherer led him to believe that electric waves could only reduce resistance by welding the particles, whereas Bose has shown that with many substances the resistance is decreased by the electric impulse.

Dr. Bose is led to choose (2) as the correct theory, since experiments seem to show that a constant E.M.F. actual does exist in the visual circuit. The feeble visual sensation, felt even in the dark, and known as the "intrinsic light of the retina," seems to be due to a real constant E.M.F. always acting in the retrial nerve circuit. Whatever view is correct, the variations of nerve current would be due to allotropic strain produced by the incident light waves.

If the effect of a luminous image on the retina is to produce a series of allotropic changes proportionate to the intensity of light at each point, then the image ought to be reproduced if an E.M.F. is applied before recovery has taken place. Dr. Bose attempted to get this result by applying an external E.M.F., but failed. Then it occurred to him that the internal E.M.Fs. of the nerves themselves might produce the required effect, which would be observed on closing the eyes immediately after the impression. His expectation was fulfilled by the appearance of "after images." These "after images" had long been known, though it had not occurred to him, up to that moment, to connect them with his investigation.

Hitherto the commonly accepted explanation of "after images" has been that they were due to fatigue of the retina. Huxley, for example, says: "The excitability of the retina is readily exhausted. Thus, looking at a bright light rapidly renders the part of the retina on which the light falls insensible; and on looking from the bright light towards a moderately lighted surface, a dark spot, arising from a temporary blindness of the retina in this part, appears in the field of view." This explanation leaves out of account a very characteristic feature of these after images, namely, that they are of an alternating or oscillating character. The after images, if produced under the proper conditions, pass from dark to bright several times in succession; and the "fatigue" theory gives no real explanation of this and many other peculiar phenomena of "after images."

According to Dr. Bose's theory, a continuous light, which is, in reality, a rapid succession of electrical impulses, brings about allotropic conductivity changes in the retina of the form represented by the diagram fig. 3. The conductivity rises rapidly to an amount corresponding to the intensity of the light, and remains practically constant at that, till the light is withdrawn. Then the conductivity suddenly falls, and may be even carried below its normal amount, and continue to oscillate above and below this normal several times. Thus are the alternate positive and negative after images, seen on closing the eyes, accounted for.

For observing the after image due to a single short impulse, Dr. Bose recommends the following method:—One end of a tube is closed by a glass disc coated with lamp-black, on which transparent letters may be scratched with a pin. Turn the blackened disc towards a strong light, and make an instantaneous exposure by means of a cardboard shutter. The eye which saw the transparent letters for a moment is immediately closed. It will be found that at first there is hardly any well-defined visual sensation, but gradually the after sensation of the luminous characters attains a maximum intensity and then fades away. This case corresponds to the curve fig. 1, where the maximum conductivity is attained some time after the instantaneous initial impulse has ceased.

The oscillating after images produced in the two eyes by long exposure to a strong light are found to be connected in a remarkable way. They are not in the same phase, but differ by a half period; *i.e.*, when the positive image is at a maximum in one eye, the negative image is at a maximum

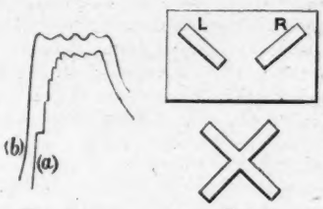


Fig. 3.

Fig. 4.

in the other. It is evident that this division of labour in binocular vision is of great advantage in the animal economy. Usually the effect is not noticed owing to the summation of the two partial effects in the brain, and also to exposure of fresh portions of the retina by the constant movement of the eye.

The effect, however, can be shown by superimposing two luminous tracks by means of a stereoscope. For this the following experiment may be arranged:—Two inclined slits L, R, fig. 4, are cut in a blackened cardboard at a suitable distance from one another. When the design is looked at through the stereoscope the right eye will see R, and the left L; the two images will appear superimposed, and an inclined cross is seen. The object of making the cross inclined is to distinguish the after-image of this particular slit from the visual memory of the erect cross.

When the stereoscope is turned towards the sky, and the cross looked at steadily for some time, owing to the alternation referred to above, it will be found that while one arm of the cross begins to be dim, the other becomes bright, and *vice versâ*, care being taken during the experiment that the eyeballs do not move.

The fluctuations become far more prominent when the eyes are closed; the pure oscillatory after-effects of the strained sensitive molecules, unaffected by the disturbing effect of further light stimulus are then obtained in the most vivid manner. To observe the difference of phase, both eyes look at the pattern in the cardboard in the manner above described. After an exposure of 10 seconds or more, the eyes are closed. The first effect after closure of the eyes is one of darkness due to rebound. Then one luminous arm of the cross projects aslant the dark field. As every portion of the retina is not equally sensitive, the after-image is not instantaneously formed in the field, but appears to jut out from one end to the other. This arm now slowly disappears, and then the second arm of the cross (produced in the other eye) shoots aslant the field. This alternation proceeds for a long time, and produces the curious effect of two luminous blades crossing and recrossing each other. Owing to the relative retardation of after-effect due to different coloured lights, the two crossing blades successively exhibit a gorgeous display of chromatic effects.

This difference in phase of half a period in the two varying currents of the two eyes, is one of those phenomena, the explanation of which may be expected to lead to an important addition to our knowledge of the nervous system. This difference of phase may be changed by subjecting one eye to different conditions of temperature and pressure, or by exposure to different coloured lights.

Dr. Bose draws attention to the fact that memory visual images seen by closing the eyes and recalling some vivid

scene impressed on the brain long ago, have the same oscillating property as the after-images of the eye. This points to the interesting hypothesis that memory, and perhaps also dreams, are due to allotropic modifications of the nerve substance which are liberated and set oscillating by the act of the will.

The outcome of this far-reaching hypothesis of Dr. Chunder Bose, in the light of modern discoveries in molecular physics may be shortly summarised as follows: The substance of muscles and especially of nerves, consists of organic molecules, the chemical bonds of which are delicately suspended like the beam of a chemical balanced so that a deflection from their position of equilibrium is easily brought about by an electric wave. These chemical bonds, as we know from J. J. Thomson's theory, are electrified corpuscles of much smaller mass than the atoms, and are, therefore, practically the only part of the molecule affected by the potential gradient associated with an electric wave. The deflection of the chemical bonds results in the formation of temporary or permanent allotropic molecules, *i.e.*, molecules in which the same atoms are combined in a different way. These allotropic changes bring about changes in the conductivity of the nerve, and hence in the electric nerve currents.

Prof. Perry has said that the future of electricity is in the hands of the chemist and the molecular physicist; it is becoming evident that we shall have to look there also for the future of physiology.

REVIEWS.

Electric Tramways. Berlin: Issued by the A.E.G. 1900.

Many beautiful and artistic *brochures*, replete with interesting matter and copiously illustrated with excellent views, have reached our hands from time to time, often from the United States, not seldom from our own manufacturers; none of these, however, can compete with one forwarded to us some time ago by the Allgemeine Elektricitäts Gesellschaft, of Berlin. This remarkable and, we should think, unprecedented production is a volume 13½ inches × 10 inches × 1½ inches thick, elegantly bound in cloth; it comprises 400 pages of the finest paper, with something like 500 illustrations, most of which are large half-tone engravings.

Commencing with a panoramic view of the interior of the company's workshops, a short account is given of the parent company, and of the allied companies to which it has given rise. The original undertaking was founded in 1883 under the name of the "Deutsche Edison-Gesellschaft," and has played a leading part in the development of electrical industry; its capital is now 60,000,000 marks, and is larger than that of any similar enterprise in Germany. The president, Herr E. Rathenau, is well known throughout the profession. Among the allied companies, numbering upwards of 50, with a capital in many cases of 10,000,000 to 30,000,000 marks, we note the Aluminium Works of Neuhausen, the Berlin Electricity Works, the Rheinfelden Power Station and Electro-Chemical Works, the Electrical Company, Limited, London, &c. A list of central stations constructed by the company follows, representing a total of 90,000 KW.

Next succeeds a general description of the various systems of electric traction—the original invention of which, by the way, is claimed for Germany, although the development of the overhead trolley system is credited to America. The first line equipped by the A.E.G. was the Halle municipal tramway in 1890, which paid from the commencement; the company has now 1,300 kilometres of track running or in course of construction, with 23,000 motor cars, and 20 lines in prospect. The "underground" (conduit) system is spoken of as costing sometimes five to eight times as much as the trolley system, while the "underground system of superficial contact" is dismissed with the remark that "up to the present no reliable distributor has been invented."

The description is written here and throughout the book in three languages—German, French, and English—in parallel columns, and is accompanied by illustrations of overhead construction and line materials. Among the latter are some interesting devices for the protection of telephone wires, including the extremely simple method of placing the earthed guard wires *on the arms of the telephone poles!* Numerous illustrations follow of car motors and trucks, controllers, special types of cars, sheds and workshops. After this introduction comes the body of the work—illustrated descriptions of tramways in actual operation. Most of these are accompanied by maps of the routes, statistics of various kinds, gradient diagrams, &c., and the views of the generating stations, depôts, and places on the tramway routes are most artistic and pleasing.

In the course of a rapid review of the descriptive matter, we note that some of the streets in Essen, through which tramways are laid, are only 3·5 m. in width! At Strassburg, in the vicinity of the University, the double trolley system is used, to avoid magnetic disturbance of the instruments in the electrical laboratories. Owing to the difficult grades met with in Genoa (the steepest being 1 in 2·7), cable trams have in some cases been found necessary; in one instance a spiral tunnel, with a rise of 12 m., and a radius of 20—25 m., is used, with ordinary trolley cars. We may add that the views of Genoa are of exceptional beauty and number. At Danzig and Duisberg the trolley lines pass over draw-bridges of the bascule type, special devices being employed to ensure true alignment of the overhead conductors at their junction. Water-tube boilers appear to be almost invariably used, and belt driving is very much in evidence.

An appendix deals with locomotives of various descriptions, an interesting elevated electric railway, 180 m. long, between two of the company's offices, and an underground section of tramway passing under the Spree, in Berlin.

To do justice to the illustrations and the general get-up of the book would be as difficult as to properly appreciate the importance and value of the work done by the company; we will content ourselves with saying that the volume forms one of the strongest arguments in favour of electric traction with overhead wires that we have ever met with.

Electric Wiring Tables. By W. Perren Maycock, M.I.E.E. London: Whittaker & Co. 1900. Price 3s. 6d.

This is a neat little waistcoat-pocket set of tables, designed to facilitate to the utmost all the ordinary operations involved in laying out an electric lighting installation. There are 36 tables in all, including the usual wire-gauges, particulars of conductors, lamps, fuse-wires, prices, ready reckoners, &c., as well as several original tables relating to the calculations for "pressure-drop," size and length of wires. The resistances and effective areas of copper cables are based on the data contained in the report of the Committee on Copper Conductors, which is reprinted in full.

A table of outside diameters of insulated cables is given, but as the type of insulation is not stated, we fail to see of what use it can be. Twenty pages are devoted to "pressure-drop"; the author advocates the use of conductance instead of resistance in all calculations in this connection, and gives full explanations and worked examples, as well as five tables showing in various ways the relations between the size, length, current and lost pressure. A table showing the variation of candle-power of glow lamps with the pressure is added, apparently for the purpose of emphasising the fact that it *does* vary; it is a somewhat nebulous quantity anyhow, and perhaps the less said about it the better.

The author strongly favours copper wire for fuses; we think he will find few engineers in agreement with him on this point. Although it is carefully stated in a short discussion of fuses, that fuse wires should not be stranded, tables showing the fusing currents of from one to ten wires "paralleled apart or stranded, preferably the former," are given, as though the difference were trifling. A useful table shows the fuse current corresponding to a given percentage increase on the normal value, the percentages tabulated being 50, 75, 100 and 150 for currents up to 20 amperes, 25 to 100 for currents 21 to 50 amperes, 12½ to 75 for currents 55 to 300 amperes; the reason why this graduated scale is adopted is not stated, but we fail to see the practical use of such low increases as 12½ and 25 per

cent.—especially with large currents, and correspondingly more important installations. The fuse should be set *high*, to prevent unnecessary extinction of the lights; the higher the better, so long as it protects the conductor from over-heating. Various methods of defining minimum insulation resistance are duly embodied in tables—a useful innovation, having regard to the enormous variety of rules. A list of towns using alternating current supply is given, all the rest being, not unnaturally, assumed to be supplied with direct current; we may point out that Blackpool, Prescot, and the Metropolitan Electric Supply Company's area possess also a direct current supply, in addition to those indicated as doing so in the table. A very useful demand indicator ready reckoner is given, as well as an explanation of the system. Misprints, so far as we have noticed, are rare and unimportant; but two innocent-looking pages are devoted to advertisements of the author's other books. The tables are well arranged, and likely to be of great use when one becomes accustomed to them; the price, however, is to our mind excessive, and will, we fear, limit the circulation of the book.

The Chemistry of Materials of Engineering. By A. H. Sexton. Manchester: The Technical Publishing Company. 1900.

This book, one of the excellent little manuals by the same publishers, is a class of book which has grown up of late years, as a result of the demand for useful information that could only be obtained by great research a score of years ago. It deals with the chemistry of materials in common use, and thus presents the engineer with a knowledge of those occult matters in engineering technics that lie at the foundation of the expert practical man's expertness. The expert foundryman who has fed his powers of observation by years of experience, attains his ends, no doubt, with an accuracy and precision comparable with the results obtained by the skilled chemist, but with this difference, that he cannot impart the fulness of his knowledge to the inexperienced, and his art and craft accompany him to the grave.

Analysis and microscopic examination will put any intelligent man into the position of a fair expert in a tenth the time required to teach him by the observation of practice. With chemical analysis it is possible for a foundry to buy its irons much more cheaply than when tied to certain brands, while at the same time in machine work may be secured by due avoidance of unnecessary hardness. In this book will be found not merely this class of information relating to the one material we have named, but to many, we had nearly said all, of the materials of engineering. Iron being *facile princeps* naturally takes the principal place; its varieties of Nos. 1, 2, 3, grey, white, &c., are all well described, and the influence of the contained carbon, or silicon, is explained.

A short chapter is given to wood, another to stone and artificial stone, another to clay and its many products, and another to cements and mortar. Fuels—solid, liquid and gaseous—are allotted more space. Our fault-finding may almost be limited to the fuels, for there is no use of the atomic values of the elements, though the author could have ably explained all that was necessary to explain in this connection. Chemical notation is used throughout the book, but no values are given. A table of atomic weights would have been useful, and perhaps would have saved reference to other books.

A few gas producers are described and illustrated, and the final chapters are devoted to lubricants, paints, varnishes and minor matters. If the book has a fault, it is that a little too much has been attempted. All the space might have been given to the metals of engineering, leaving the other minerals to a second volume, timber to a third, and fuels and such to a fourth, for the author is eminently suited to the preparation of them all.

Bloemfontein.—The electric lighting works, which have been erected at a cost of £18,000 to the town have been formally opened. Messrs. Reunert & Lenz were the contractors.

MOTOR VEHICLES.

In our last issue we published at some length a review on Mr. W. Worby Beaumont's new book on "Motor Vehicles and Motors." Since its insertion, however, it has been brought to our knowledge that certain statements therein contained are not merely inaccurate, but entirely incorrect.

The most important and misleading of these are embodied in the remarks with regard to the illustrations and the subject of brake horse-power. So far from the scales having been omitted from the working drawings, we find that in the bulk of instances both English and metrical scales are given, and the whole of the line drawings were specially drawn for the book—in many cases from the actual mechanisms, taken apart for the purpose; moreover, no part of the matter was derived from, or in any way connected with, catalogues. The subject of brake horse-power is also suitably dealt with, and other points on which our reviewer commented adversely we find, on examination, to be in order.

This being so, we have decided to unreservedly withdraw the review, and in doing so, we wish to express our regret that it should have been so worded as to do an injustice, unintentional it is true, but none the less detrimental and misleading, to Mr. Beaumont's valuable work. We owe it to him to say that Mr. Beaumont has met our voluntary offer to do this in the same spirit in which it was conceived; our only desire is to do even-handed justice, and it is our misfortune, not our fault, that we have in this case inadvertently fallen short of our ideal. For this reason, we are anxious to make the frankest acknowledgement and the fullest reparation in our power.

Eds. Elec. Rev.

CURRENT SPECIFICATIONS.

XXXIX.—WAKEFIELD EXTENSION.

Summary.

Extent of Contract.—Supply of one 400-kw. steam alternator.
Type of Engine.—Triple expansion high speed vertical engine.
Output.—550 b.h.p.
Speed.—Not to exceed 350 revolutions per minute.
Overload.—*Twenty per cent.* for two hours.
Working Pressure.—135 to 140 lbs. per square inch.
Condensing Plant.—To be supplied under separate contract.
Voltage of Alternator.—2,000 to 2,200 volts.
Periodicity of System.—60 ~ per second.
Permissible Temperature Rise.—Not to exceed 70° F. above surrounding atmosphere after eight hours' full load run.
Range of Regulation.—To be within 7 per cent. between no load and full load at constant speed and excitation on non-inductive load.
Exciter.—An exciter wound for an E.M.F. of 180 volts, to be direct coupled to alternator.
Insulation Resistance.—Armature to core 20 megohms, magnet to core 5 megohms.
Efficiency.—Efficiency at various loads to be stated, and steam consumption guarantees given in tender.
Specified Date of Completion.—August 30th, 1901.
Penalties for Late Completion.—*One per cent.* on contract sum per week.
Specified Terms of Payment.—80 per cent. on completion of work, 10 per cent. after one month's regular running, 10 per cent. after six months' satisfactory running.
Specified Period of Maintenance.—Six months.
Stipulations as to Wages and Arbitration Proposals.—None.

We have here the shortest set of general conditions we have seen for a long time. The specification has been drawn up by Mr. Robert Blackmore, the city electrical engineer, and it cannot be said in any way to restrict manufacturers offering their standard sizes of plant. Triple expansion high speed engines are asked for, and guarantees as to their performance are to be given by tenderers.

No arbitration proposals are made in the general conditions, but no special powers are claimed for the engineer, so presumably there would be no objection to inserting one in the final contract. In the same manner there is no reference to wages to be paid by the contractor to his workpeople or any stipulations as to the powers of the engineer to demand the removal of any of the contractor's employés.

The following are the only three clauses needing attention, and in reference to the first it will be noticed that separate tenders are asked for engine and alternator, so that the penalty would only be payable on the value of the portion of the plant late:—

In case the contractor shall fail to complete his contract by the above date, he shall be liable to the Corporation for and as liquidated damages at the rate of 1 per cent. of the total amount of his contract per week, for every week over and above the date specified for the completion of his contract. The engineer shall have power at all reasonable times to inspect the materials and workmanship at the maker's works, and be given 14 days' notice of the completion of the plant, so that he or his assistant may be present at the final tests of the plant. The contractor shall be responsible until the final payment is made for any defects arising from bad materials, design, or workmanship, fair wear and tear excepted. And should for any cause any defect arise during the aforesaid six months, such final payment shall be kept back until the plant is running to the satisfaction of the engineer.

XL.—SWINDON ELECTRIC LIGHTING.

Summary.

Contract No. 1.—Supply and erection of steam dynamos, balancer, and motor-generator.

Number of Steam Dynamos Required.—Three.

Output of each Dynamo.—Practically 200 kw., 417 amperes at any voltage between 440 and 500 volts as shunt machine, and as compound-wound machine 525 volts and any current between 50 and 380 amperes.

Specified Overload for 10 *Minutes.*—Practically 250 kw., 475 amperes at 525 volts.

Type of Engine.—Three-crank enclosed, vertical triple expansion type.

Working Conditions.—175 lbs. per square inch working pressure and a vacuum of 24 inches maintained by condenser supplied under separate contract.

Specified Piston Speed.—Not to exceed 600 feet per minute.

Type of Dynamo.—Multipolar, suitable for both lighting and traction work.

Insulation Resistance.—To be tested after erection, for fields 1 megohm, for armatures 750,000 ohms.

Foundations.—To be supplied by contractor, and cost of same included in price.

Capacity of Balancer.—To consist of two machines directly coupled together, capable of dealing with a current of 100 amperes in the middle wire of a three-wire system having a difference of pressure of 220 to 240 volts between middle and either outer.

Specified Speed.—Not to exceed 700 r.p.m.

Motor-Generator.—To consist of two 13-kw. dynamos directly coupled to and driven by one motor.

Specified Speed.—Not to exceed 600 r.p.m.

Specified Date of Delivery.—18 months from date of order.

Penalty for Late Completion.—£20 per week.

Specified Terms of Payment.—75 per cent. of value of work done upon delivery on site, balance up to 90 per cent. of contract sum on satisfactory completion, 10 per cent. 12 months later.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages Paid to Workmen.—See below.

Arbitration Proposals.—Limited, see notes below.

Date for Receipt of Tenders.—December 24th, 1900.

The consulting engineers who have prepared this specification, and are acting as advisers to the Corporation of Swindon, are Messrs. Lacey, Clirehugh & Sillar. The steam pressure is higher than is at present customary in English stations, and the engines are stipulated to be of the three-crank triple expansion type. If any other type of engine is tendered for, a detailed specification of the plant offered has to be sent.

A number of forms are given, asking for particulars and guarantees.

Contrary to usual practice, the contractor must provide foundations for the plant, though the excavating and filling in will be done by the Council. Provision must be made in tender for foundations 6 feet deep; if any additional depth is required, it will be allowed for as an extra.

Provision is made in the general conditions, Clause 7, that if through discrepancies between the drawings and the specification, errors have crept into the tendered price, they shall be rectified, and an allowance, determined by the engineer as fair and reasonable, shall be made.

The contract drawings have to be submitted to the engineers for approval within four weeks after acceptance of the contract, "*showing all essential details, including foundations and other work to be executed by the Council in connection with the work,*"

This must mean all information to enable the Council to arrange for the excavating, for the foundations themselves are to be provided by the contractors.

The maintenance clause reads:—

The contractors shall guarantee the efficiency of the works for a period of one year after completion, or for such longer period as may be stated in the specification, and shall maintain the works in perfect repair during such period, fair wear and tear being allowed for.

The clause dealing with the wages to be paid by the contractor to his employés is of such a character that it may be accepted in principle, but it should be noted that any disputes arising under this head are withdrawn from arbitration and are specified to be decided by the engineers.

This following paragraph:—"*Any question arising as to what are the standard rate of wages and hours and conditions of labour to be settled by the engineers, whose decision shall be final,*" tends to limit the operation of the arbitration clause which at present provides for the submission of certain classes of disputes to arbitration. It will be noticed that two arbitrators are to be appointed, one chosen by either party. It is thus expressed:—

In case any dispute or difference whatsoever shall at any time or times hereafter arise or exist between the contractors and the Council touching their respective rights or obligations under the said contract, or the fulfilment or non-fulfilment thereof or incident thereto, *other than such matters as are hereinbefore specially directed, and any dispute as hereinbefore appears is intended to be referred to or decided by the engineers as mentioned,* such dispute or difference shall from time to time, at the instance or request of either party, be submitted to and decided by the arbitration *of two arbitrators, one to be nominated by the contractors and the other by the Council,* the proceedings under and consequent upon the said last-named reference shall be conducted, and any award or awards to be made thereunder shall be subject to and governed, conducted, and affected by all the incidents, consequences, and effects of a reference to two arbitrators under the provisions of the Arbitration Act, 1889.

While there is little risk involved in the acceptance of this condition, as a matter of principle we object to all these limitations, and suggest that tenderers ask for an unlimited right of appeal to an independent authority in cases of dispute.

LAYING OUT MINE FIELDS IN THE ROYAL NAVY.

To lay out a row of submarine mines for the defence of a harbour or narrow channel, at first sight appears to be a very simple matter; the destructive radius of each mine is known, and the chart is at hand to give the depth of water; thus it would seem that after the mines are "fused" all that remains to be done is to tow the mining launch across the mine field, dropping the mines at regular intervals, and carrying the cables ashore to the observatory from which they are fired.

As a matter of fact, however, there is much to be gone through in the way of surveying, and laying the mines down in accurately plotted positions.

In former days the mines were fired from two positions, that is to say, two observers were stationed at some distance apart, so that the position of each mine subtended a fairly large angle between the two observers. When the first observed a ship to be crossing his line of observation, he pressed his key, and waited for No. 2 observer, who also pressed *his* key when the bearings came on, and completed the circuit.

If the ship was at the spot where the two lines of observation cut one another, she was exactly over the mine, and both observers having their keys depressed, the mine exploded.

Now, however, an ingenious instrument, called the "depression position finder," has done away with the necessity of two observing stations, and rendered the operation of firing the mine automatic.

The depression range finder, or, as it is usually termed for brevity, the D.P.F., consists of a telescope, mounted on a revolving arm, which the observer swings round by means of a training wheel, much the same as if training a gun. The arm carries a metal point over a chart, and the mines

are represented on the chart by little brass heads; the metal point coming in connection with one of these little brass heads, completes the circuit of the particular mine represented. Thus, when the ship is in the centre of the telescopic field the metal point is exactly over the spot on the chart which represents her position; and when her position is immediately over the area of destruction of the mine, contact is made by the metal point, and the mine exploded.

So far we have been supposing the ship to be following a line represented on the chart by the arc, described by the metal point. The telescope is, however, capable of another movement. The D.P.F. is always placed at a height above the mine field, and the telescope is capable of depression, so that the nearer a ship approaches, the greater is the amount of depression that must be given to the telescope in order to keep her in the centre of its field.

Laying Out Mines in the Royal Navy.

The rack and pinion which alters the depression of the telescope, at the same time slides the metal point in, along the movable arm, over the chart at a speed exactly in proportion to the motion of the line of vision over the mine field. Thus, by following a ship with the telescope, an exact representation of her movements is made by the metal point upon the chart. All, then, that the observer is required to do, is to keep the ship in the centre of the field of his telescope.

But the depression range finder has another use, in very much reducing the labour of constructing the mine field; it becomes, in fact, an automatic surveyor, for instead of it being necessary to fix the position of each mine by means of angles from the laying-out boat, and carefully plotting them out by scale and protractor on the chart, it is only necessary to run the boat along a given course and watch for signals from the observer at the D.P.F. The position at which it is proposed to drop each mine is carefully laid down on the chart, and then the observer takes his place at the telescope, following the boat along her course; a pencil is substituted for the metal point, and when it comes directly over each plotted position, the signal is made to the boat to drop her mine. At the instant of dropping it the position of the pencil point is marked, and thus a perfect chart of the mine field is obtained.

It will be seen that the range finder may be used entirely for purposes of surveying if required, once its height and position are known; there is a vernier on the instrument marked off to represent the height, and by this scale the axis of the telescope is raised above the chart to a height corresponding to the height of the instrument itself above the water-line.

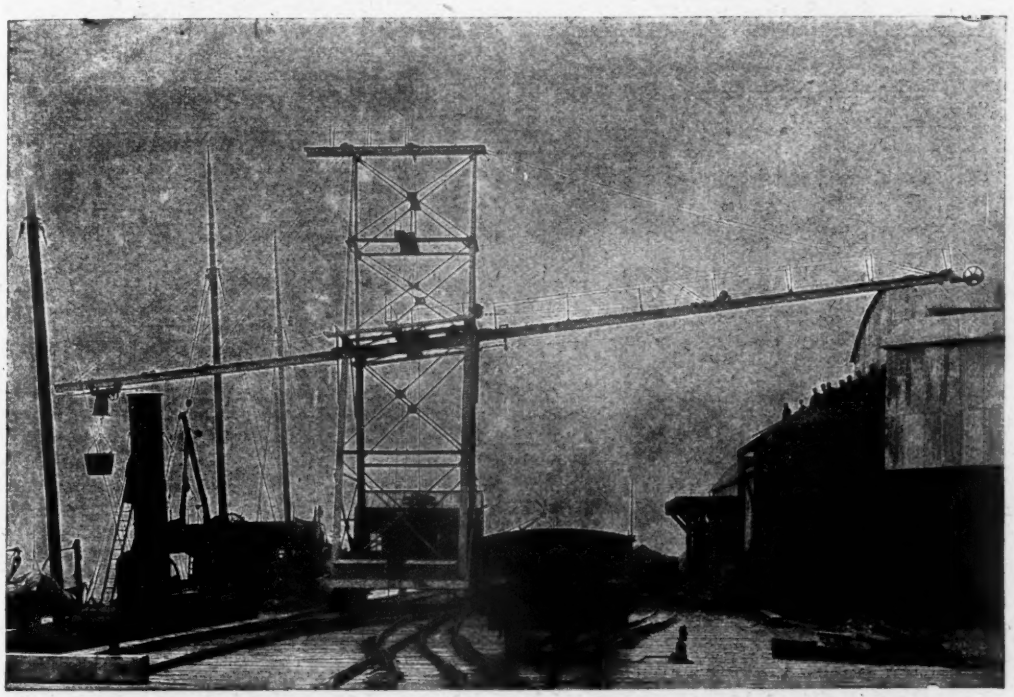


Fig. 1.—Temperley Transporter at Ellesmere Port.

THE TEMPERLEY FUEL TRANSPORTER.

It is unnecessary to inform our readers that one of the most important developments which is taking place in electricity works is the adoption of mechanical methods for the conveyance of fuel from railway siding or canal barge to the boiler furnaces. In all recently equipped stations of any particular capacity, this has been made a special feature by the designing engineer, and the engineer

in charge, who is responsible in a large measure for the degree of economy that is obtained in the operation of electric generating plant, is eager to avail himself of this particular means of reducing the fuel-handling account to its minimum amount. As some of our smaller systems of electric supply are developed, and require the stations to be extended with consequent greater fuel consumption, the question will force itself to the front, and works which now carry the fuel and fire the boilers by manual labour, will adopt the more convenient method for dealing with the larger quantities.

Descriptions of various plants for handling large supplies of fuel have from time to time appeared in the Electrical Review in the course of our accounts of electric tramway and railway stations at Dublin, Shepherd's Bush, and other places, and of electricity supply works at Glasgow, Wandsworth, Clerkenwell, Willesden, and so forth. In the present article we propose to devote special attention, particularly to one form of conveyer, viz., the Temperley transporter.

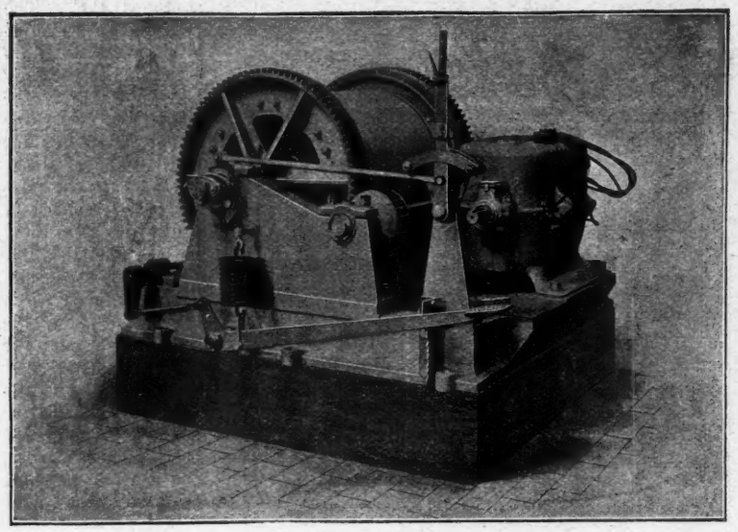


Fig. 2.—Two-Speed Electric Transporter Engine.

This system of coal transportation is in vogue at the Willesden generating station of the Metropolitan Electric Supply Company, the works of the Smelting Corporation at Ellesmere Port, and various other places. The Willesden plant deals with a load of 22 cwt. at a lifting speed of 200 feet per minute. The transporting speed when loaded is 600 to 800 feet per minute, but when empty 800 to 1,000 feet. The transporter is operated by a G.E.800 electric motor of 20 h.p. 100 volts, running at 520 revolutions per minute. The wagon elevator in the tower lift is also worked by a similar motor.

The transporter at the Ellesmere Port works on the Manchester Canal is constructed to carry loads of 30 cwt., and the stability of the tower is sufficient, without rail clips or blocking, to admit of this load being lowered with great rapidity and brought sharply to rest, so that it is always open to the driver to move the installation in either direction to meet the requirements of taking the coal from different parts of the hatch of a vessel or depositing it at different points on the stock heap.

The engine, illustrated in fig. 2, is capable of lifting the full load at a speed of 300 feet per minute, and of travelling the load along the transporter beam at a speed of 600 feet per minute. It is fitted with machinery for raising and lowering the hinged arm of the transporter which projects over the vessel, and for travelling the tower along the rails in either direction. The hoisting drum runs loose on the shaft for lowering, and is put into gear for hoisting by means of a friction cone of large diameter; the engine is not, therefore, fitted with reversing gear, and the wear and tear of ordinary link action is avoided.

An overhauling or tail rope is attached to the traveller and connected to a set of counterbalance weights for the double purpose of preventing the traveller from overrunning the hoisting rope in the

Fig. 3.—The Loaded Skip being Lowered for Upsetting.

Fig. 4.—The Skip in the Act of Righting Itself after having been Automatically Upset.

Automatic Dumping Fall Block and Skip.

event of the driver reducing the speed of his engines too suddenly when travelling the load along the transporter at such a great speed as 800 feet per minute and for accelerating the speed of the return journey down the transformer beam.

The traveller (which is the same as that illustrated in our description of the Glasgow electricity works, Electrical Review, September 21st, 1900), carries the load and the rope carriers which support the hoisting rope at intervals of 50 to 60 feet throughout the length of the transporter beam.

Figs. 3 and 4 represent the automatic dumping skips which are used for conveying the coal from the hold of the vessel in which they are filled, to the stock heap. They enable one man working the transporter to take the loaded skips from the vessel and deposit the contents on the stock heap without breakage or creating a cloud of dust, and they also secure a rate of working which would be impossible if the skips had to be upset by a man stationed on the stock heap. Apart from the difficulty which a man experiences in scrambling about on the top of a heap of raw material, he naturally stands clear of the skip which is being lowered with great rapidity, and considerable time is lost in his reaching the skip to disengage the catch and capsize it. The output of the entire plant is altogether controlled by the man employed to upset the skips.

The Temperley skip, on being lowered to any desired point, is capsized by the action of lifting, and, as it is self-righting, it is returned to the vessel locked and ready to be refilled. Before leaving the vessel the dumping mechanism is thrown out of action by the movement of a lever, and does not come into action again until the fall block has entered the bell of the traveller and the load has commenced to travel up the transporter beam, so that there is no possibility of the skip being dumped automatically on to the heads of the men in the vessel. If the men omit to throw the dumping mechanism out of action the skip upsets immediately on the commencement of the lifting.

Transporters of this type are constructed for either a double or single line of rails to pass beneath the tower.

The Ellesmere Port transporter is electrically driven, but it is not connected with the electricity works. The waterside arm is made to hinge up. The plant is driven by a G.E. 1,000 electric motor of 30 B.H.P. (250 volts) running at 450 revolutions per minute. The controller is of the R 17 type. The electrical equipment in both the Willesden and Ellesmere Port cases was supplied by the British Thomson-Houston Company.

CORRESPONDENCE.

Electrical Vehicle Trials.

Mr. Opperman's letter, which appeared in your issue of November 30th, calls for a few remarks.

As a body, I think, the owners of the cars would repudiate the suggestion that the trials were too severe—or that the constant running under the difficult conditions ruined, or tended to ruin, the batteries.

It appears that such a suggestion is far more calculated to injure the growing industry than the trials themselves. It is well known that one firm ran their car upon the Southsea tour with the same batteries that had been used throughout the trials—and it may be interesting to say that the identical set of batteries has now been sold for lighting purposes.

This does not seem to indicate that they were damaged by the severe conditions of the trials.

It is quite true that some dissatisfaction was felt by the manufacturers engaged. These points will, no doubt, be remedied in future trials of electromobiles, which the Automobile Club may conduct.

The matters which chiefly affected the owners were:—

(*a*) The trials being only suitable for certain classes of vehicles. It is well known that light electromobiles are constructed for town use and for light work. On such cars powerful motors are unnecessary, and they are not provided. The trials all took place under the same severe conditions, thus excluding several types of carriage. Manufacturers not being consulted as to the trials, were consequently quite in the dark as to what class of car they should enter. It was naturally presumed that the trials would be varied. As a matter of fact, it was a prolonged hill-climbing test.

(*b*) No decent arrangements were made to enable carriages to be attended to; expensive cars were housed in broken-down sheds of the most filthy description. There were inches of liquid mud on the floors; rain came through the roof; the sheds were doorless, and the cars and attendants were nightly exposed to the full force of wind and rain. On the first night two cars had to stand in the open. It rained the whole night! No information being given as to where the trials were to be held, no arrangements could be made for the lodging of the attendants. One company, which had entered several cars, found that the hotels near the charging station were already occupied. As a result, their staff had to be divided between two hotels, each more than a mile off the charging station, and over two miles from each other. As all charging of cars took place at night, the inconvenience and expense of this arrangement was considerable.

(*c*) Those who had entered cars were treated as competitors, instead of as manufacturers with one object in view, namely, the progress of electromobilism. Most stringent and unprecedented rules were enforced with the utmost severity, and the conditions generally were not calculated to bring out the advantages of electrical self-propelled traction. In spite of these restrictions, the following is the unbiassed view of one of the leading electrical papers* :—

"The results obtained under great disadvantages must be accepted as proving the practicability of electrical propulsion on common roads. The trials in every way established the commercial utility of the electromobile once for all in this country. The long-distance run on rough roads and through hilly districts on one charge, the ease of control, their reliability, smoothness in running, absence of vibration, and economy of electric energy, make the electrically-propelled carriage an assured success."

It is necessary to add that the officials at the charging station did everything in their power to assist those engaged on the trials, and their courtesy was the redeeming feature of the week. It is, however, to be hoped that much more efficient charging arrangements will be made on any future occasion.

Theodore G. Chambers.

Supply Station Accidents.

I have been interested in the correspondence appearing in the recent issues of the Review on the subject of "Supply Station Accidents," and as I have had some experience in successfully preventing accidents from shocks, I may, perhaps, be able to give a few suggestions that will be of use.

I think it is admitted that the ordinary india-rubber glove of commerce is impracticable, at least I found it so, and to overcome the difficulty I had cotton gloves coated with pure Para rubber issued to the men; these gloves fitted properly, so there was no difficulty in handling small terminals, &c., and the cotton kept the hands fairly dry and comfortable. Of course, if they got oil on them often they did not last very long, but that is a very small matter when weighed against human life.

In addition to the gloves we served out india-rubber soled shoes, not the article of commerce, but good strong canvas shoes with soles of best red rubber $\frac{3}{8}$ inch thick. The men were obliged to put on the shoes when they came into the station each day, and leave them when going out.

I consider that shoes are preferable to using mats, unless where a man must lie down or kneel to do his work, in which case mats are indispensable.

The gloves and shoes should be in charge of some individual who would examine them carefully now and again, as the average workman will not bother, he prefers running a risk.

During the six or seven years I was engaged in central station work I never had an accident due to shock.

A. E. Porte.

Surface Electric Railway Cars.

Mr. Langdon's able paper has almost demonstrated what many have long suspected, viz., that the early part of the coming century will see the extension of electrical traction to our great railway systems. The steam locomotive has reached its limit, and (alas that it should be so!) is doomed to go; nor will its place probably be taken by any electrically-propelled tractor, for this would be to do away at once with one of the great advantages of electricity—that, namely, of making each vehicle an independent unit propelling itself. We may, in fact, look forward to an era of trains consisting of long cars, each with its own motor or motors, controlled by the driver on the foremost one. It should not perhaps therefore be outside the province of electrical engineers to consider the most suitable way of mounting such cars to adapt them to various conditions. Is the double-

* Electrical Review, November 23rd, 1900.

bogie method the best; or would it be more convenient to have the motor *attached to the body of the car* and driving two *fixed* axles (or three even) at the centre, with radial axles or bogies at the ends? These are practical mechanical questions resulting from the new conditions that will require investigation with a multitude of others, for the electrical engineer of the future will be called upon to provide cars capable of carrying heavy loads at probably higher speeds than those to which we are accustomed, and this, too, in the most economical manner.

Alfred J. Allen.

London Institution, *December 10th.*

Authorship Made Easy.

I observe in the current number of the *Engineering Magazine* an article under the heading of "Central Station Practice in England," with the name of the author given as Mr. Frank C. Perkins, who is good enough in the concluding paragraph of the article to state that the data and photographs, from which the illustrations have been produced, were furnished by myself.

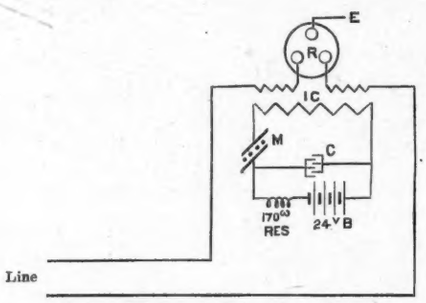
The circumstances of the case are peculiar. Mr. Perkins, sometime in the beginning of this year, writing from Buffalo, New York, after seeing a description of these stations in various English and American technical papers, asked me if I would send him the manuscript of the articles and any photos, &c., so that the description might appear in the *Western Electrician* or some other paper. I did so, and the present article so closely follows the wording of the description then sent that, except for some paraphrasing of sentences indulged in by Mr. Perkins, not always to the advantage of accuracy of description, the article now appearing in the *Engineering Magazine* is nothing more nor less than a copy of my own article. Is this quite fair?

A. J. Lawson.

London, S.W., *December 10th*, 1900.

A Telephone Query.

By experience I have found that with a microphone circuit as used in telephony, joined up as follows—



E, Earth; R, Differential receiver; I C, Differential induction coil
M, Microphone; C, Condenser; B, Battery.

—having a condenser shunted across the primary, the speaking is considerably improved.

It is not clear to me how this improvement is obtained; if one of your readers could enlighten me I should feel obliged.

No doubt it appears to you that the 24 v. battery is of an unusual strength, but it is already used for another purpose, and the inserted resistance reduces the output to the required amount.

Fred. C. Chapman.

The German Post Office Transmitter.

I note with considerable interest the notice contained on page 914 of your last issue relating to the new German Post Office telephone transmitter, and as an individual closely connected with this branch of the electrical industry, I should be much interested to know whether the competition mentioned was open to all the world or to German manufacturers only, as this information would considerably enhance or detract from the importance of the result.

F. G. B.

December 10th, 1900.

[We understand that the competition was not confined to German manufacturers, but was open to all who wished to enter. We do not think, however, that the matter was publicly advertised in this country.—Eds. Elec. Rev.]

Information Wanted.

I should be obliged if you could tell me, through the medium of your "Correspondence" column, the principle and uses of the Edison electromotograph, and when it was invented.

N. E.

[Perhaps one of our readers will kindly furnish a reply.—Eds. Elec. Rev.]

The Molecular Constitution of Water: a Correction.

It reads in your last issue that ice is dihydrol: it should be *tri*hydrol.

Steam is hydrol = H_2O;
Ice is trihydrol = $(H_2O)_3$;
and Water is a mixture of *di* and *tri*hydrol = $(H_2O)_2 + (H_2O)_3$.

J. C. R.

London, *December 8th*, 1900.

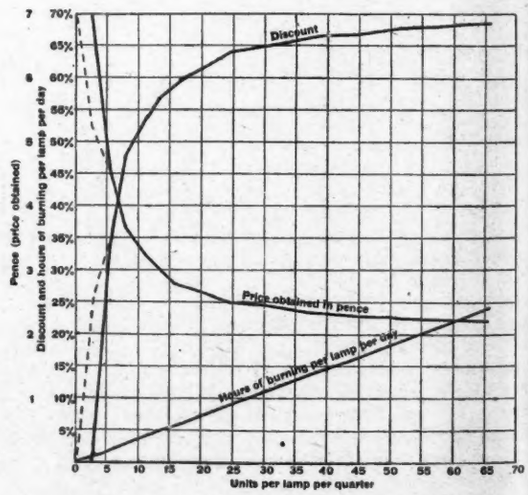
Charging for Electrical Energy.

Perhaps the following method of fixing the charges to the public for current consumed may be of interest to you. The idea is based on charging 7d. per unit. as a maximum, with rebates to long-hour consumers.

The method of working is as follows:—The total number of lamps (of 8 c.p. 30 watts) each consumer has installed is first ascertained, and the number of units consumed is read off the meter; the units are then divided by the number of lamps (total installed in each installation) and the discount or rebate is then obtained from the curve. Thus, a man has 10 8-c.p. lamps installed, and his consumption comes to 100 units per quarter—100 ÷ 10 = 10. Refer to curve, and it will give you 51½ per cent. discount, and the resultant bill will be 100 × 7d. = 700d. less 51½ per cent. = 340d.

This method certainly charges a man with many lights fixed, and low maximum demand, at a higher rate than the man with few lights and high maximum demand.

To overcome this a supplementary curve is shown dotted, which will, I think, meet the case, and the increased



maximum demand caused by charging on all the lights fixed is balanced by the rebates, as shown dotted.

For one night's blaze, or, maybe, one hour's, by Wright's

system, the consumer has to pay the full rate for the whole of the quarter, whilst by the proposed system a blaze for a night or two does not make any difference to him except the current consumed. At the same time it induces consumers to have lamps fixed only where they will be really used, and these are the lamps the station engineer wants, not a lot of seldom used or short-hour lamps. The curve can be made to suit any price charged per unit, as desired. Briefly, the advantages are, it does away with the demand indicator, makes the method of charging simple and understandable to the average consumer, and relieves him of the bugbear, a demand indicator.

A. W. D.

Newcastle-on-Tyne,
November 29th, 1900.

ELECTROLYTIC PRODUCTION OF SODA AND CHLORINE

In the *American Electrician* of October, 1900, Mr. James F. Hobart describes a new form of three-fluid cell for the electrolysis of salt solution. There are two diaphragms; the outer compartments contain the anode and cathode, while the inner contains a neutral solution of salt. Mr. Hobart claims that the products of this cell are more pure than in the ordinary one-partitioned type, there being no difficulties arising from the production of hypochlorites; it would seem, however, that the two partitions and the inner neutral solution would cause such high internal resistance as to make the cell of little use for commercial purposes.

We reproduce below our contemporary's account of the apparatus. There are several forms of three-fluid cells, some of which are illustrated herewith. The siphon diaphragm cell, fig. 1, seems to possess infinite possibilities, and is apparently worthy of close consideration. In the elevation it is shown that the diaphragms are formed of tubes, which are filled with some porous material, so as to act by capillary conduction; asbestos and porous cement are two materials used for filling the tubes. As shown by the plan view, the diaphragms may either be small round tubes, or they may be large flat ones, only one or two being required for each diaphragm; both kinds are shown in the engraving. The round tube diaphragm is more easily made, handled, and kept in repair, but the flat tube has the lower electrical resistance, hence it gives the better results.

The value of diaphragms of this kind lies in the ease with which they may be applied to any vessels of the sort and shape suitable for electrolytic cells; also in the fact that the vessels themselves may be employed as anode and cathode.

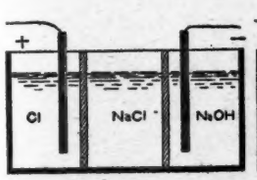


Fig. 2.—Three-fluid Cell.

Fig. 3.—Duplex Cell.

Fig. 4.—Direct Diaphragm.

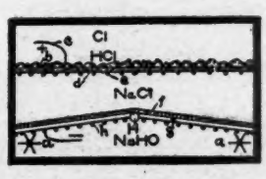


Fig. 5.—Horizontal Diaphragms.

When a single tank or cell is fitted with one or more diaphragms, measures must be taken to construct the cell of non-conducting material, otherwise a good deal of electric energy will be lost by conduction. A great disadvantage of this form of diaphragm is its thickness, which causes a great deal of internal resistance. To obviate this fault, the tubular diaphragm was evolved into the plate form, which is shown by fig. 5.

In the operation of the three-tank triple-fluid siphon diaphragm cell, the liquid in the left-hand tank becomes saturated with chlorine until no more of that gas will be held in solution in the water contained in that division of the cell. After the liquid has become fully saturated—become dilute hydrochloric acid, in fact—the chlorine will bubble up and pass off as fast as it is formed. In the cathode tank, the soda deposited combines with the liquid in like manner, and the solution may be drawn off when found to be sufficiently concentrated; but, in first starting this kind of a cell to work, it will be found impossible, with any reasonable E.M.F., to force current through the three cells after they have been freshly filled, the middle one with salt solution and the others with pure water. To obviate this difficulty, it is necessary to put a few pounds—the quantity varying according to the size of the tank—of HCl into the left-hand compartment, and to dissolve some soda in the other tank. This gives the water sufficient conductivity to

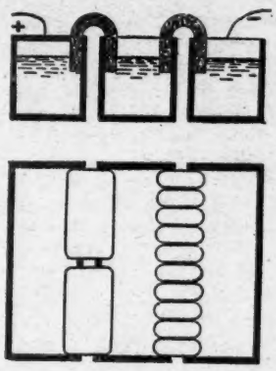


Fig. 1.—Siphon-Diaphragm Principle.

enable the current to pass; once started, the current will soon deposit enough of both elements to establish the proper conductivity, and the conductivity will increase up to the point of saturation.

Probably the purest ions can be obtained with an electrolytic cell of this kind, or with the kind illustrated by fig. 2. Here the siphon arrangement has been modified into a simple division, as shown more fully in fig. 5. In fig. 2 a single tank contains the three fluids, which are separated by two diaphragms. Otherwise the operation of this cell is precisely like that just described and illustrated by fig. 1.

Fig. 3 represents a three-fluid cell known as the "Duplex." The middle tank forms the cathode, while two anodes are used, each being in a separate cell of its own. The siphons used in this cell are filled with a salt solution, there being no asbestos or other absorbent material inside of the siphons. The "straining" action is secured by burying one end of each siphon in the carbon of the anode which it serves.

At first sight this form of construction appears to settle the diaphragm question, but upon more closely studying the matter, grave defects are apparent. The ions are liberated at the surface of each electrode, and the points directly opposite each other have never less than their regular share of the work; therefore the part of the anode which closes the tube becomes the most effective part of that terminal. Hence the greater proportion of the ions are liberated inside of the tube, and in the case of chlorine and hydrogen they rise to the highest part of each tube where, if not drawn off by a pump, they have the effect of cutting off the electric current entirely as soon as the tube is filled with gas at the bend.

It is evident from the form and nature of siphon diaphragms that they were suggested by and are modifications

of the "wicking" connection between cells. The wicking was threaded through a tube to keep it in shape and to prevent it from becoming dried up, soiled or injured, by careless handling. It was found that the elements soon decomposed the cotton wicking, and recourse was had to asbestos, or some other material, not subject to electrolysis; hence the evolution of the siphon diaphragm.

In using this form of connection between two cells it did not take long for the experimenter to become acquainted with the faults of the device, to obviate which he shortened the long tube and connected the two tanks or cells direct, as shown at *a*, fig. 4, instead of running over the top, as shown on the left. The shortness of the tube proved so great an advantage, that it was enlarged, as at *b*, and the next step was to further shorten the length of the tube, and to increase its area, until it covered the whole side of the cell, and became a plate or film. No sooner was this improvement effected, than trouble began in another quarter. The big thin diaphragm, although electrically satisfactory, would not remain in place; it would buckle and go to pieces. One result of the numerous efforts to obtain a satisfactory diaphragm has been the abandonment of vertical diaphragms, and a dependence principally upon the difference in the specific gravities of the fluids to keep them separate, the dividing line being horizontal instead of vertical, as in the ordinary bluestone primary cell. Fig. 5 shows such a cell, in which, however, the separation of the fluids is facilitated by very thin mechanical divisions.

In this cell, which must be built of glass, slate, or some insulating and non-corrosive material, there are two light diaphragms of asbestos cloth, or some other similar material. The upper diaphragm, *d*, is laid on a lattice work or grating, *e*, of non-corrosive rods; directly on this diaphragm the anode material is laid, which may consist of lump carbon packed evenly all over the surface of the diaphragm. The positive wire, *c*, is connected to the carbon, and it will be well to use platinum wire inside of the cell, and to make several connections with lumps of carbon in different parts of the mass in order to ensure good conductivity between all of the pieces of carbon and the terminal.

The lower diaphragm, *f*, is laid on a similar grating of iron; or iron rods or pipes, *h*, may be put in, and iron strips, *g*, may be laid upon the rods; then iron wire netting is spread over the iron strips, and the asbestos cloth is placed upon the netting. This makes a strong form of diaphragm, and the iron, in its support, serves as the cathode. The strips, *g*, are used to provide a number of uninterrupted passages to the pipe, H, which carries off the hydrogen gas evolved during electrolysis. The negative terminal is connected to the iron grating, as shown near *h*. A couple of agitators, *a*, *a*, are provided to keep the electrolyte in motion, so that gas will not adhere to the cathode and cause polarisation. The lower diaphragm is made roof-shaped for the purpose of leading the gas to its pipe and facilitating its exit from the cell.

In operation, the tank or cell is nearly filled with a saturated salt solution (NaCl), leaving sufficient room at the top for the chlorine to accumulate. Current being turned on, the ions are separated, and the upper and lower solutions gradually become nearly pure, and as indicated by the chemical symbols in the engraving. If it is desired to start the process so as to secure pure ions from the beginning, it will only be necessary to fill the lower compartment with water, fill the middle compartment with salt solution, and let in some water above the top diaphragm; there is no need of priming the cell with caustic soda and acid, as must be done with the three-fluid cells shown by figs. 17 and 18.

The natural tendency of the three liquids is to keep apart, and this tendency is much strengthened by the passage of current; these two forces, augmented by the very light diaphragms, are sufficient to do all that is required in this direction.

Ayr.—Application is to be made for further borrowing powers to the extent of £25,000, in view of the extension of the electricity station for tramway purposes.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Dec. 12th, 1899.		Week ending Dec. 11th, 1900.	
Adelaide	Value £19	Alexandria	Value £1,343
„ Teleg. mat.	100	Amsterdam	25
Amsterdam	60	Antwerp	242
Auckland	53	Bangkok	38
Bangkok	126	Beira. Teleg. mat.	311
Buenos Ayres. Teleg. mat.	1,228	Bombay	67
Calais. Elec. batteries	60	Buenos Ayres	59
Calcutta	31	Calcutta	262
Cape Town	259	Cape Town	268
Chinde. Teleg. mat.	611	„ Teleg. apparatus	80
Colombo. Teleg. wire	34	Christchurch	66
Constantinople. Teleg. wire	35	Colombo	48
Copenhagen. Teleg. mat.	180	Copenhagen. Teleg. wire	76
Durban	677	Durban	58
„ Teleg. mat.	3,202	„ Teleph. mat.	97
East London	14	Genoa. Teleg. mat.	38
Fremantle	20	Gibraltar	9
Hamburg	405	Halifax	12
„ Teleg. mat.	290	Hamburg. Teleg. mat.	600
Hong Kong	180	Hiogo	140
Kobe	106	„ Teleg. mat.	76
„ Teleph. cable	396	Hobart	22
Liban	35	Hong Kong	150
Melbourne	38	„ Teleph. mat.	115
Odessa	151	Kure	200
Perth	250	Leghorn. Teleg. mat.	81
Port Elizabeth. Teleg. wire and mat.	322	Lisbon	1,100
Port Said	20	Malta	21
Reval	210	„ Teleg. mat.	65
Rotterdam. Teleph. cable	100	Melbourne	532
Shanghai	79	Nagasaki	108
Singapore	17	Ostend	447
Stockholm. Teleg. wire	310	Penang. Teleg. mat.	212
Sydney	392	Port Chalmers	65
Tokio	30	Rangoon	60
„ Teleph. cable	691	Singapore	88
Townsville	45	Stockholm. Teleg. mat.	79
„ Teleg. wire	220	Sydney	555
Trinidad	46	Wellington	40
Wellington	67	„ Teleph. and matrl.	900
„ Teleph. mat.	1,234		
Total	£12,352	Total	£8,766

Foreign Goods Transhipped.

Brisbane. Teleph. appar.	Value £909
Melbourne. Elec. motor	9
Yokohama. Teleph. apprts.	63
Total	£981

Books Received.—"Technical, Industrial and Commercial Vocabulary—French, English, German," by E. Hospitalier. Paris: L'Industrie Electrique. 6 f.

"Transactions of the American Society of Mechanical Engineers." Vol. xxi. 1900. New York City: Published by the Society.

"Knowledge Diary and Scientific Handbook" for 1901. London: *Knowledge* Office. 3s.

Buchanan & Co. v. Bishop.—The plaintiffs carry on business as electricians at 60, Victoria Street, S.W., and they sought to recover £4 11s. 9d. from Mr. Bishop, a builder, of Barnes. The case was tried on Thursday, December 6th, in the Westminster County Court, by his Honour Judge Lumley Smith, Q.C. Plaintiffs were engaged in putting in an installation at a house which defendant was building for a Mr. Glennie at Putney. After the work was complete, it was found that the defendant in laying the flooring in one room had driven the nails into the wires and through the casing. It took some time to find out where the defect was. When the boards were put down screws should have been used. It took about a week to put the wires right. The defence was that the damage was very small and would be covered by 30s. His Honour said he thought a trade discount of 15 per cent. should be allowed, and he therefore gave judgment for the plaintiffs for £4 and costs.

Catalogues and Lists.—The J. C. Nicholson Tool Company, of Newcastle-on-Tyne, have sent us a well illustrated catalogue of their machine tools. Varieties of lathes, drilling, planing, shaping, slotting, milling, boring machines, steam hammers, saw benches, forges are included. Spare sheets are also being circulated in which their latest machine tool improvements are detailed, these being their horizontal drilling machine and propeller shaft keyway milling machine.

Messrs. Pirelli & Co., of Milan, who received a *grand prix* at the late Paris Exhibition, have placed before us a set of their lists and catalogues. Their principal works are at Milan, but they also have works at Spezia for the construction of submarine telegraph cables, and at Paris their exhibits of gutta-percha, &c., were shown. Several of the lists before us deal with this department of the business; another gives, in tabulated form, details of their insulated electric cables. The others detail a very large variety of rubber, gutta-percha, and ebonite goods.

Messrs. Davies, Kent & Stewart send us a circular of their "flush" wall or floor socket, giving prices.

Mr. Archibald J. Wright, of Upper Street, N., has issued a trade circular of his small electrical goods and scientific and mechanical novelties. These include pocket accumulators, electric jewellery, small motors and dynamos, coils, lamps, alarm clocks, &c.

Twentieth century telephones specially adapted for private houses, hotels, and offices, are described in a very neatly arranged circular which has been issued by the Berliner Telephone Manufacturing Company, of 117, Queen Victoria Street, E.C. We understand that the company's trade in England has developed so rapidly

as to render it necessary to establish a branch business at the above-mentioned address. This branch will be under the management of Mr. Isidore Birnbaum, and will keep a full stock of every description of telephones, &c. A catalogue is now in course of preparation.

We have received from the Commercial Cable Company one of their excellent wall calendars for the year 1901.

Pamphlet No. 113 of the standard manufactures of Messrs. S. Z. de Ferranti, Limited, is a reprint of a long illustrated article which appeared in a contemporary early in the year. It is a description of the works and of the apparatus which has made "Ferranti" a familiar name to electrical engineers all over the world. The firm will send a copy of the pamphlet on application.

Correction.—In our last issue, under "New Companies," we gave some particulars of the flotation of Isidor Frankenburg, Limited, which are not quite correct. The capital of the company, instead of being £25,000, as stated by us, is £250,000. The name of the company is Isidor Frankenburg, Limited, not Isidor Frankenburg & Co., Limited.

For Sale.—In an "Official Notice" to-day particulars will be found of one 20 and two 9-N.H.P. Crossley gas engines, and two dynamos (190 amperes 110 volts, and 127 amperes 115 volts), also belting, which are offered for sale.

Foreign Electrical Plant.—The imports of foreign "electrical goods and apparatus" into this country during November last attained a value of £149,537, as compared with £174,524 in the previous months. The aggregate imports during the 11 months ending with November last have amounted to £1,118,760.

A Handbook of Knowledge.—From *Knowledge* office, High Holborn, there comes to hand a copy of the *Knowledge Diary and Scientific Handbook* for 1901, 3s. net. As a diary and memoranda book for the desk it serves a very useful purpose. During the next few months we shall hear a good deal about what has been done in different branches of science during the past century, and one of the features of this handbook is what purports to be an historic summary of the advance of science in the nineteenth century. With such a vast ground to cover in a few pages, anything like fulness of detail is hardly to be expected, but our finger alights upon one section of the historic review which does not give one a very high opinion of its accuracy—we refer to electric traction. We are there given to understand that "with the exception of small tramways at Portrush and Bessbrook, in Ireland, and Brighton, Blackpool, South Staffordshire, &c., in England, we have no electrically-driven trams; but the City and South London Railway, with the overhead line in Liverpool, and the two electric lines *now being constructed* in London, show that we are at last waking up." The &c., of course, may be comprehensive of the 40 and more other trolley lines which are in operation in the United Kingdom, but the whole paragraph looks as though it was written about four or five years ago, when things were just beginning to wake up. The reference to underground railways also lends authority to the opinion that the matter has not been recently written, for the Waterloo and City and the Central London have both been in operation long enough for most Londoners to have become fully acquainted with them. The case for electric traction is altogether understated, not only in regard to this country, but America as well, for we read that in the United States there are 12,133 miles of electric, and 599 miles of cable trams. We remember seeing some such figures as these four or five years ago, and to-day several thousands of miles ought to be added to the electric, and a goodly number deducted from the cable lines. Electric trams have been extending there very rapidly, and, on the other hand, cable traction has been stepping aside for electricity to take its place repeatedly of recent years. Sir W. H. Preece had not received his title when this history of the century was written, for "our own countryman, Mr. Preece," is said to be closely associated with the transmission of messages "without intervening wires." The writer says, toward the conclusion of his review, that "intellect is on the stretch to get forward." We would suggest that he takes a good long stretch to bring himself up to date, then perhaps he may think about getting "forrader." We cannot discover any system in the arrangement of the matter, and it looks very much as though it has been cut out of *Knowledge* issues during the past few years, thrown all of a heap, and left to arrange itself. We, of course, appreciate the difficult task before a man who attempts to compile a history of all the sciences in one article, so that perhaps we ought not to say of this what is generally said of "a little knowledge." Anyhow, we presume that the blank memoranda pages are the main object of the book, and these are excellent, leaving nothing to be desired.

Liquidation.—Creditors of the Nuneaton Electric Company, Limited (in liquidation) must send particulars of debts, claims, &c., to H. B. Harris, New Bridge Street, Nuneaton, by February 1st, 1901.

Large Traction Generators.—The Westinghouse Electric and Manufacturing Company have just completed the erection of a 2,700-KW. electric traction generator at the works of the Boston Elevated Railway Company. This generator, one of the largest traction units yet made, has been tested to the satisfaction of the railway company. When the Westinghouse Company bought the business of the Walker Company, they took over this contract and introduced several important changes in the design of the machine; the armature windings were altered, the methods of ventilation and insulating were changed, a new type of commutator was designed and constructed, and the Westinghouse method of balancing armature electric circuits was utilised. Another generator of the same size, but entirely of Westinghouse design, is now under construction for the railway company.

London County Council.—The Public Control Committee, at a meeting of the London County Council on Tuesday, submitted a report on the subject of boiler explosions, with special reference to the conclusions of the Select Committee whose report was issued last July. In this connection the Committee drew attention to the explosions which recently occurred with fatal results at the generating station of the Crystal Palace Electric Lighting Company and at the Sardinia Street station of the Metropolitan Electric Supply Company. The Committee expressed the opinion that steps should be taken for the amendment of the law as suggested in the report of the Select Committee, and the Council resolved to forward letters to the Home Secretary and the President of the Board of Trade, expressing the hope that the Government will take action to give effect to the recommendations contained in the report of the Select Committee.

It was decided on the recommendation of the Building Act Committee to approve plans submitted on behalf of the Charing Cross and Strand Company for the erection of a sub-station in St. Martin's Lane, Strand. An application for sanction to plans for an addition to the station of the Woolwich District Electric Light Company was not granted on the ground that the construction of the roof was deemed unsatisfactory.

The Highways Committee submitted a report referring to the action brought against the National Telephone Company to restrain the company from carrying out underground works without first obtaining the sanction of the Council.

Personal.—On December 7th, at Falcon Works, Loughborough, Mr. E. W. Jones was made the recipient of a high class planimeter, presented to him by members of the Brush Company's staff on his leaving to take up the position of leading draughtsman to Messrs. Reavell & Co., of Ipswich.

The Electrical Company, Limited, of Charing Cross Road, have instituted a special department for cables, wires, and insulating material. Mr. A. Heilborn has been appointed manager of the cable department.

Smoke Nuisance.—The Central London Railway Company were last Saturday fined £3 in respect of each of seven summonses at the instance of the Hammersmith Borough Council. The summons was heard at the West London Police Court by Mr. Rose. Mr. Maurice Hill, in addressing the magistrate for the company, said he did not dispute that there was black smoke occasionally for a few minutes, but special precautions were taken to obviate it. He pointed out that the company were, under the Act of Parliament, bound to have their trains and generating station going, so that they were not in a position to deal with the matter so completely as those who conducted private establishments. It was stated in evidence that certain deliveries of coal had been stopped because the quality was unsatisfactory. Mr. Rose said he appreciated the difficulty in obtaining a proper supply of coal from the collieries. He imposed a penalty of £3 in each of the seven summonses, with two guineas costs. He declined to grant higher costs.

Trade Announcements.—Mr. F. R. Batty, formerly manager of the installation department of Donnison, Barber & Co., Manchester, has now joined Mr. A. G. Sanders, of Cheltenham, as manager of the Gloucester and district branch, at 18, King Street, Gloucester.

The National Electric Wiring Company has removed to Connaught Mansions, 34, Victoria Street, S.W.

ELECTRIC LIGHT AND POWER NOTES.

Aberdeen.—A new 700-H.P. Willans-Westinghouse steam dynamo has been installed at the Corporation electricity works, and the station is now capable of meeting all possible demands, whether for lighting or traction.

Bexhill.—A public inquiry was held last week by Col. C. H. Luard, R.E., relating to the application of the D.C. for leave to borrow £7,772 for extensions of the electricity works. Mr. Preece explained the proposed additions to the plant, and stated that there had been a great increase in the number of consumers.

Bombay.—The Committee of the Corporation appointed to consider the question of providing electric power for the city of Bombay, has recommended that the concession for 42 years be given to Messrs. Killick Nixon & Co., Bombay, as agents for Messrs. Kilburn & Co., Calcutta, who represent Messrs. Crompton & Co. in India.

Boston.—The prov. order of the T.C. has been confirmed, and the Council has resolved to obtain a report on the electric lighting of the town from Mr. Adrian Collins.

Bridgwater.—In a recent issue the *Journal of Gas Lighting* published a criticism of the estimates prepared by Mr. Trentham for the electric lighting of Bridgwater, in connection with the Local Government inquiry held last month. At this inquiry, Mr. Valon, acting for the local gas company, undertook to prove that Mr. Trentham's estimate of £14,248 should be increased to £21,657 in order to cover the proposed works, while instead of a profit balance of £43, there would be a deficiency of at least £665 per annum. For this purpose, Mr. Valon dealt with the estimates and the tenders received in detail, the latter, in almost every case, being higher than the former, while Mr. Valon also added certain amounts to cover items which, he said, Mr. Trentham had left out of

consideration. Replying to this criticism, however, Mr. Trentham pointed out that the tenders amounted to £16,538, not £21,657, and they were based on a 250-kw. plant and an increased length of mains, whereas the original estimates provided for 170 kw. only, and a smaller network. Moreover, as these tenders covered the complete equipment of the works, with all necessary adjuncts, Mr. Valon's additions were unjustified; Mr. Trentham, however, showed that the latter were in themselves erroneous, and brought forward actual results proving the accuracy of his estimates of running costs in small towns. Space does not permit of our reproducing the details in full, but the evidence before us appears to be ample to justify Mr. Trentham's contentions.

Brighton.—The T.C. intends to purchase two new steam dynamos, at a cost of £9,698. The foundations of the new works at Southwick will be constructed of concrete, at a cost of £22,530.

Bristol.—The question of the appointment of an architect for the new electricity works at Avonbank has now been finally disposed of by the T.C. It will be remembered that Sir Benjamin Baker approved of Mr. Faraday Proctor's designs for the foundations, with certain additions, and the E.L. Committee asked the Council to rescind the resolution passed early in the year to the effect that an architect be appointed. This the Council has refused to do, by a majority of one, and consequently an architect must be engaged.

Burgess Hill.—The U.D.C. is to apply for a provisional order.

Bury.—The T.C. has appointed Mr. A. T. Smith assistant electrical engineer at a salary of £110, rising to £150. The E.L. Committee has agreed to support the Westminster Electric Supply Corporation's agitation for the amendment of the B. of T. regulations.

Clayton.—The D.C. has received notice of an electric lighting order to be submitted to the Board of Trade by Mr. C. Chadwell, of Blackburn. It was considered advisable that joint action should be taken with Great Harwood, their interests being identical.

Colchester.—The T.C. has resolved, on the advice of Mr. Sillar, the electrical engineer, to apply to the L.G.B. for leave to borrow £12,000 for extensions of the electricity works.

Colombo.—Mr. E. Cockerill, the consulting electrical engineer of the Colombo Municipality, has been asked to furnish a report on the electric lighting of Kandy.

Crewe.—Mr. Walter T. Kerr, of Greenock, has been appointed assistant electrical engineer at a salary of £104 per annum.

Doncaster.—The new workhouse, which has cost nearly £100,000, is lighted throughout by electricity.

Dorking.—A special meeting of the U.D.C. was held last week to further consider the offers made for the transfer of the Council's prov. order for electric lighting in the district. It was unanimously agreed to transfer the order to the West London and Provincial Electric Supply Company, Limited, on the terms of their offer, subject to certain conditions. It was also resolved to lodge notice of objection to the application to be made by the County of Surrey Electrical Power Distribution Company, Limited, to the B. of T. for a prov. order. The proposed transfer is subject to approval by the Board of Trade, and if sanctioned, the Council decided to engage Mr. Trentham, electrical engineer, to advise upon the proposed scheme and works.

East Ham.—It is estimated by the engineer that it will cost £6 12s. capital outlay and loan charges for wiring each double tenement artisans' dwelling. Certain public streets are to be lighted by arc lamps.

East Molesey.—The U.D.C. has received a notification of the withdrawal of the Edmundson's Electrical Corporation's application for a prov. order affecting the district, but the company offer to supply current in bulk from their station at Twickenham.

Halifax.—On the 10th inst. there was a complete stoppage in the supply of electricity at Halifax, and in the shops and houses which had not the alternative of gas illumination candles had to be resorted to. It was caused by the bursting of a pipe at the electricity works. At the Town Hall some of the municipal committees were holding their fortnightly meetings. After the lapse of about an hour the supply for lighting purposes was resumed, and about half an hour later the tramcars were enabled to run as usual.

Hanley.—The L.G.B. has sanctioned the borrowing of £5,000 for extensions of the Corporation electricity works, and the B. of T. has approved of the proposed change from 100 to 200 volts declared pressure.

Helensburgh.—The Gas Committee has resolved that the proposal to obtain a prov. order for the introduction of electric lighting into the burgh be abandoned.

Hunstanton.—The U.D.C. has resolved to apply to the B. of T. for an electric lighting prov. order.

Kirkcaldy.—The T.C. has resolved to light the tramway route from Links Street to the Cottage Hospital electrically, also the thoroughfares leading to the railway station, at an estimated cost of £14,000.

Kettering.—The B. of T. has deferred the question of revoking the U.D.C.'s prov. order for electric lighting until June 30th next.

Kingston-on-Thames.—The Board of Guardians have decided not to light their new buildings by electricity. The estimates for gas lighting per annum work out at £856. The next lowest tenders, for electrical installations, were, with plant, £918, and taking current at 4d. per B.T.U. from the Kingston Corporation, £1,687.

Leigh.—At a recent meeting of the Tramways and Electricity Committee of the T.C., the electrical engineer reported that a number of motors had been applied for. It was resolved that tenders be obtained for their supply, and application is to be made for the sanction of the L.G.B. to a loan of £500 for their purchase.

Llangollen.—The U.D.C. has decided to apply for a prov. electric light order.

Long Eaton (Derbyshire).—The U.D.C. decided on Monday to purchase 2,000 square yards of land from the Midland Estates Corporation for a site for the proposed electric lighting works.

London.—Hammersmith.—The Borough Council has decided that application be made to the L.C.C. for a loan of £15,000 for extending the electric mains in the borough.

Madras.—Experiments have recently been made in lighting the Moore Market with arc and incandescent lamps, the work being carried out and energy supplied by the Madras Electric Tramways Company.

Maldon.—The D.C. has received notice that the County of Surrey Electrical Power Distribution Company does not intend to proceed with the electric lighting scheme.

Middlesbrough.—The Corporation electricity works are almost ready to commence supply; the demand is said to be already equal to the capacity of the station, and extensions will be necessary in the near future.

Neath.—The Corporation have been asked by the Electrical Power Distribution Company, Limited, to support their intended application for a prov. order to supply the district with electricity. The Council is going in for an order, and decided that it could not consent to the company's application.

New Malden.—The Surrey Electrical Power Co. have notified the U.D.C. of the withdrawal of their scheme for lighting the district.

Pocklington.—The U.D.C. deputation has reported recommending the adoption of a similar electric lighting scheme to that of Northallerton, if it can be installed on a paying basis. The town will consider the matter.

Ross.—The prospectus of the Ross Electric Light and Power Company, Limited, has just been issued. The company starts with a capital of £8,000. It is intended to supply current continuously on the low pressure system by means of a plant equivalent to 4,210 lamps of 8 c.p. each. The maximum prices proposed are 8d. per unit for light and 5d. per unit for power. The estimated cost of the proposed installation, including £4,000 for machinery, is £7,800.

Shepton Mallet.—The U.D.C. has resolved to apply to the B. of T. for powers to supply electricity in the district.

South Shields.—The revenue account for the electric light works for the six months ending September 30th shows a gross profit of £1,332. The expenditure was £2,467 and the receipts £3,799, the latter including £2,803 from sale to private consumers. The sum of £1,124 is carried forward.

Stafford.—It was stated at last week's Council meeting that the consumption of gas had increased this year by 4 per cent., and the consumption of electricity by 100 per cent.

Stockton.—It has been arranged to open the Corporation electric lighting works on Tuesday, December 18th.

Stratford-on-Avon.—A company is applying for electric lighting powers, but the Council has now decided to try as well, feeling sure that the company will be disappointed.

Stroud.—The D.C. has resolved to obtain an expert's opinion as to the cost of an installation of electric light, at a fee not exceeding 25 guineas.

Tonbridge.—The U.D.C. has decided to adopt Mr. Hammond's scheme for the electric lighting of the district at a cost of £20,000.

Warwick.—The Council has rescinded the resolution passed at the last meeting, by which consent was given to the British Electric Traction Company's application for an electric light provisional order. Mr. Carter said the reason for withdrawing the leave was because the electric light station would not be in Warwick. Mr. Purser said the company had every wish to have the station in Warwick, but declined to tie their hands in this matter.

Wells.—In reply to a communication from the B. of T. as to exercising the powers of their prov. order for electric lighting, the Wells T.C. replied on Monday, that they did not propose taking any steps at present.

West Bromwich.—The E.L. Committee of the Corporation has decided that the charge for hiring out motors be 10 per cent. per annum on the cost of the motor and of the installation.

Widnes.—The T.C. has resolved to apply for a provisional order.

Worsley.—The D.C. is to apply for a provisional order.

Yeadon.—The B. of T. has revoked the D.C.'s electric lighting order. A syndicate having informed the D.C. of its intention to apply for lighting powers, the Urban and Rural D.Cs. in the Wharfedale Union are to be asked to join a conference on the matter. The same syndicate has approached the Wharfedale R.D.C., which, however, has decided to remain neutral.

Yorkshire.—The Huddersfield T.C. and several U.D. Councils in the district are lying in wait for developments in connection with the scheme of the Yorkshire Electric Power Syndicate, Limited.

ELECTRIC TRACTION NOTES.

Bombay.—The Bombay Tramways Company, after waiting patiently 15 months for a reply to their request that the municipality should give them a renewal of their lease on condition that they adopted electric traction instead of horse traction, have now withdrawn their offer. The municipality is, therefore, without any scheme for the carrying on of the tramways when the lease expires shortly.

Bristol.—The last of the horse cars disappeared from the Bristol tramway system on Saturday night last, and on Sunday the whole of the sections previously operated by horses were worked by electricity. This was rendered possible by the visit to Bristol of Mr. Trotter, of the Electrical Department of the Board of Trade, who spent a whole day in inspecting the new power house at Counterslip, and in riding by electric car over the lines on which it was proposed to introduce electricity. These were divided into two classes; first, new lines and extensions of old ones; and secondly, lines on which horse cars have been running for years. Mr. Trotter's certificate, that electrically the requirements of his department had been complied with, applied to both of these classes, but inasmuch as the former had not been inspected by Colonel von Donop, who has to certify for the arrangements of the permanent way, only those in the second category could be opened, and the new lines and extensions have to await the Colonel's visit and approval. Immediately after Mr. Trotter had given his permission, the new power house was brought into use, cars on the railway station section being worked by current from it instead of from the older station at St. George. Other sections were dealt with in quick succession on succeeding days, 175 new cars being used for the work. Intervals between the starting times were materially shortened, and fares modified in favour of the travellers in several cases. The cars carry 53 passengers each, are beautifully fitted up, and have been doing a very large amount of business. Although electric traction was only in use for the latter part of the week, the returns showed an increase for the week of £434. The whole of the extensions and new lines are ready for operating directly Col. von Donop can go to Bristol and pass them. On the Victoria Street section, which passes the Bristol railway terminus, the cars are only a minute apart; on the greater length of the Redland line they are separated by intervals of 1½ minutes, and in every part of the city the acceleration has been material.

Cardiff.—A consignment of rails has already been received for laying the new track for the Corporation electric tramway system, and work will now be started next week.

Dublin.—Breakage of an overhead conductor led to a stoppage of the electric trams in Dawson Street for a couple of hours on Tuesday last week.

Electric Traction on Railways.—At the annual dinner of the Leeds Association of Engineers on Saturday evening, the Right Hon. W. L. Jackson, M.P., chairman of the Great Northern Railway Company, expressed disappointment that no mention had been made in the speeches of the progress of electric power in connection with engineering works. He asked if they were going to apply within a reasonable time that great power to the main lines of our railways. Electricity had been very successfully applied to tramways, and its application to the railways would work a revolution in this country.

Italy.—Public attention in Northern Italy has lately been directed to the extension of the Aosta Railway either to Chamonix or Martigny, and the President of the Provincial Council has sent for one of the engineers who have studied the line, Signor Cedali, and informed him that it is the intention to apply for a Government concession, giving a subsidy of 500,000 lire from the Provincial Government. The subsidy to be asked from the National Government is 5,000 lire per kilometre for a term of 70 years. The estimated total expenditure is 56,000,000 lire for the 75 kilometres. Mr. J. Cook, of London, is interested with Signor Cedali in this undertaking.

Lincoln.—The Corporation have resolved to acquire the tramways undertaking in the city and to adopt electric traction. The Electricity Works Committee reported on their negotiations with the company with reference to the terms upon which the undertaking could be acquired, and recommended the Council to proceed with tramways Nos 1, 2, 3, 4, and 5, and to appoint an electrical engineer to prepare a report as to the estimated cost of the tramways. The Council has adopted the recommendations.

Liverpool.—On Sunday the new electric tram route between Dale Street and Seaforth, Liverpool, was opened for passenger traffic. The opening of this line has brought nearly the whole of the northern residential part of Liverpool into electrical communication with the centre of the city. The route connecting Breck Road with the north docks, and so establishing communication between the centre of the city and Seaforth, *vid* the Breck Road and eastern district routes, will be complete in a few days.

London United Trams.—It seems that the Board of Trade will not allow the L.U.T. Company to set its electrical trams running at the moment, pending the settlement of the problem of protecting Kew magnetic observatory from interference by leakage. It appears that the company, which has already spent £15,000 upon experiments between Hounslow and Chiswick, is now required to spend another £50,000 for preventing leakage. The Kew observatory officials want insulated returns laid down. The trams have been ready to run for three weeks past. The L.U.T. Company would like the observatory shifted.

Liverpool and Manchester Electric Railway.—Mr. Behr gave particulars of his amended high-speed railway scheme for Manchester and Liverpool at a meeting of the Institution of Electrical Engineers at Owens College, Manchester, on Tuesday. He said they proposed to attain an average speed of 110 miles an hour. They calculated that the power required to attain that speed on a train weighing about 45 tons would be about 1,500 H.P. That power would require about 2,000 H.P. in the central generating station. After making allowances for contingencies, they calculated that the total power required at the central station would be about 7,500 H.P. Under circumstances they could increase the number of carriages running from four to six, and the carriages of the smaller type could carry 7,500 a day in either direction, or a total of 15,000 a day. The voltage at the central station would be very high, probably between 12,000 and 16,000 volts. Mr. Behr said he had designed a special conductor completely protected, from which nobody could possibly get a shock. A discussion followed, in which the electrical engineer for Manchester and Alderman Sir Bosdin Leech took part. The hope was expressed that Mr. Behr's next effort to get a Bill through Parliament would be successful.

At the meeting of the Salford T.C. last week the resolution of the Parliamentary Committee recommending the Council to oppose the Manchester and Liverpool Electric Express Railway Bill to be promoted in the ensuing session of Parliament was adopted. Alderman Robinson mentioned that this was practically the same scheme for a mono-railway which was brought forward last year, but that the line of route had been materially altered.

The scheme is being pushed forward, and plans and sections of the altered proposals have been placed before local authorities whose areas are affected.

Manchester.—The Manchester Association of Engineers on Saturday resolved:—"That this meeting is of opinion that it is desirable, in the interests of the British engineering industry, that the Manchester City Council should have as expert for the electric traction scheme a capable British engineer."

Middleton.—The T.C. proposes to borrow an extra £12,442 for electrical purposes, this amount being required to provide power for the trams of the British Electric Traction Company. The total cost of the scheme is now about £31,000.

New Malden.—As the result of a poll the U.D.C. has decided not to oppose the Tramway Bill of the London United Tramways, Limited, so far as it affects the district, subject to the company withdrawing the line through Coombe. The Council also agreed to oppose all competing schemes, especially that of the Kingston Corporation, subject to protective clauses being granted in the Bill, and on the company paying Parliamentary expenses; £1,500 towards a drainage scheme; and assisting, together with the railway company, in sundry street improvements.

North Wirral.—The Birkenhead Council has had placed before it the scheme of a syndicate desirous of constructing a light electric railway to connect the Wallasey electric tram system through Meols, Leasowe, Hoylake, West Kirby, Caldy, Frankby, Greasby, and Upton with the Birkenhead electric tram system at the north end of the borough. The company is prepared to enter into any agreements necessary to keep the control of the lines in the borough under the Corporation.

Nottingham.—The delay in opening for public traffic the first section of the electric tramways—from Sherwood to the Great Market Place—was mentioned at last week's Council meeting. The chairman (Alderman Brownsword) said he could not at present mention any date for the starting of the new system. Everything had been completed except the cars. The contract had been entrusted to an eminent firm, but the work was three or four months late. The bodies of the cars were in the shed, but the equipment was not complete.

Oldham.—The official inspection of the first section of the electric tramways system took place last week. The section inspected was that running on Middleton Road, between Rochdale

cost of £14,000.

any steps at present.

Road and the borough boundary, this portion of the work having been carried out rapidly, so as to comply with an undertaking given by the Corporation to have the line between Featherstall Road and the borough boundary running by the 15th inst. The section is less than a mile in length, and, for a considerable portion of the distance, is of a very steep gradient, the heaviest pull being 1 in 11¾. The permanent way has been laid by the Corporation, under the direction of Mr. S. H. Pickering, A.M.I.C.E., the borough surveyor, and the electrical equipment, which is on the overhead system, has been supplied and fixed by Messrs. W. T. Glover & Co., of Manchester. Messrs. J. P. Hall & Co. supplied two 66-kw. direct-driven dynamos at 550 volts at 440 revolutions per minute, of the two-pole drum bar armature type. Four cars have already been delivered by Messrs. Dick, Kerr & Co. from their works at Preston. These are of different types, to accommodate respectively 28, 38, 48, and 58 passengers. The smaller cars are single-deckers, and the larger ones are two-deckers. They are fitted with pneumatic, electric, and hand brakes.

Piacenza (Italy).—An application for a concession to construct and work an electric tramway from San Niccolo to Agozzano has been made in the names of Mr. A. J. Lawson, of London, and Signor Ingegnere Torquato Perdoni, of Ponte dell'Olio, who also seek powers to construct a canal and abstract water from the River Trebbia to provide the necessary hydraulic force to generate electricity for the working of the tramway and for the lighting of the towns and villages through which the lines will pass. The application has the support of the various local authorities.

Southport.—The inner circle of the Southport electric tramway system has been completed and opened for traffic. The line connects the markets with Ash Street, a distance of three miles, and the fare covering this is 1d. Pending the completion of the Infirmary and Kew Gardens route, a 12 minutes' service will be maintained.

Workington.—The E.L. Committee of the T.C. recommends the Corporation to refuse to grant any concession, and to oppose any application before Parliament in connection with the part of the West Cumberland electric tramways scheme relating to Workington.

TELEGRAPH AND TELEPHONE NOTES.

Cables to the West Indies.—It is stated that a movement is on foot to improve the cable communication between the British West Indies and the United Kingdom. Sir Cavendish Boyle, the Acting Governor of British Guiana, recently addressed a letter to the Governors of the West Indian Colonies inviting the views of their Governments on the subject. He pointed out that as the existing contract between British Guiana and the West India and Panama Telegraph Company would expire at the end of 1901, the necessity for obtaining a cheaper and improved cable communication with the United Kingdom and the West Indian Colonies—preferably over British lines—presented itself with additional force. He suggested that as the Home Government had appointed a Departmental Committee to inquire into the present system of telegraphic communication between different parts of the Empire, it seemed doubly necessary that some movement should be made by the various Colonies as soon as possible. The Governor of Barbadoes, in his reply, suggested that each Colony should address the Secretary of State, expressing its willingness to consider terms with any Company prepared to lay a complete British cable. Other Governors replied in more or less favourable terms.

Glasgow Telephones.—The Corporation telephone exchange system will not be completed so soon as was expected. Contractors will be two or three months behind.

London Telephones.—In reply to a question asked in the Commons by Mr. Bartley on the subject of the obstruction of London streets, Mr. A. Chamberlain said that the Postmaster-General was aware, and was sorry that it should be so, of the great inconvenience caused by the works in connection with the extension of the telephone service in London. The Post Office was not responsible for the whole of the inconvenience caused, though every endeavour would be made to mitigate the inconvenience so far as the Post Office was concerned. The Electric Light Companies had, under their statutory powers, in many cases been laying their wires along the same routes as those followed by the Post Office.

Newport Telephones.—The Corporation has asked the Parliamentary and Improvement Committee to consider the advisability of establishing a municipal telephone system.

The Telegraph Wire Export Trade.—November proved to be a very active month as regards the export trade of this country in telegraph wire and apparatus connected therewith, the value of the month's shipments amounting to no less than £230,430 as compared with £114,253 in the previous month, and £260,239 in November, 1899. To the end of November last the aggregate exports reached a total of £2,814,159, as contrasted with only £1,360,819 in the first eleven months of 1899.

Telephonic Communication with Glasgow.—The *Times* says that on December 8th Lord Londonderry received at the General Post Office a deputation from Scotland to protest against a proposal of the Post Office to cut off their special wires to Glasgow. It appears that some large firms arranged with the National Telephone Company to have special wires communicating with the telephone exchange in Glasgow, as there were too many delays by going on the public trunk wires. The Government took over the trunk wires from the National Telephone Company in 1896, and the Government contend that by the agreement with the National Telephone Company all the business should come on the trunk lines. The deputation pointed out that their agreements with the Telephone Company were made prior to the trunk wires being acquired by the Government; that the facilities given on the trunk lines were not such as would meet the demands of their business; and that the royalty paid by the deputation to the National Telephone Company would equal, if not exceed, any charges payable to the Government for the use of the trunk wires. At the close of the interview Lord Londonderry said he should consider the matter and see whether any possible arrangement could be made to meet the difficulty.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
African—St. Louis (Senegal)-Bathurst	Aug. 25, 1900	
Zanzibar-Mombassa	Sept. 29, 1900	Dec. 8, 1900
South American—Pará-Maranham	March 1, 1900	
Pernambuco-Ceara	Nov. 29, 1900	
Cayenne-Pinheiro	Nov. 26, 1900	
Barcelona - Guanta - Cumana - Portlamar-Carupano (Venezuela)	Nov. 1, 1900	
Chinese—Shanghai-Foochow	Dec. 7, 1900	Dec. 11, 1900
Shanghai-Amoy	Dec. 7, 1900	Dec. 11, 1900
Falmouth-Bilbao	Nov. 19, 1900	
Latakia-Cyprus	June 20, 1899	
Landlines:—		
African—Majunga-Tananarive	Nov. 6, 1900	
South American—Communications with all offices of Colombia beyond Buenaventura	January 23, 1900	
Interior of Colombia landlines	Nov. 19, 1900	
Ecuador landlines	March 3, 1897	
Landlines west of Barquisimeto and Coro	Nov. 1, 1900	
Barcelona (Venezuela)-Ciudad (Bolivar)	Nov. 1, 1900	
Communication with Carthagena and Baranquila	Dec. 8, 1900	
West Indian—Landlines to Baracoa, Guantago and Sagua de Tananamo	Nov. 12, 1900	
Landlines between Puerto Plata and San Domingo City	Nov. 20, 1900	
Chinese—Tientsin-Pekin	June 12, 1900	
Pekin-Kaigan	June 14, 1900	
Kaigan-Maimatchin	June 30, 1900	
Tientsin, *viâ* Shanghai	June 16, 1900	
Tientsin-Niuchwang	June 18, 1900	
All lines connecting Cochin China with Thuanan	Oct. 23, 1900	
Communication between Saigon and North Annam and Tonkin	Oct. 23, 1900	
Communication "*via* Hanekine" interrupted on Persian territory	Feb. 24, 1900	

Wireless Telegraphy.—Colonel Hozier, on behalf of Lloyd's Committee, has notified Glasgow shipowners that it had been decided to establish experimentally the reporting of vessels by ætheric signalling at Inishtrahull, North of Ireland. It is expected that the installation will be ready by the middle of January. Arrangements are also being made for night signalling as well as day at Kildonan, Arran, Scotland.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—December 22nd. The E.L. Committee wants tenders for storage batteries. See "Official Notices" November 30th.

Asylum.—December 29th. The Committee of Visitors of the Winwick County Asylum, near Warrington, invites tenders for electric lighting, wiring, fittings, &c.

Ayr.—December 14th. The Tramways Committee wants tenders for overhead work, poles, brackets, section boxes, &c.; also underground work (feeders and other cables, conduits, trenching, &c.) for the electric tramways. See "Official Notices" November 30th.

Birkenhead.—December 18th. The Corporation wants tenders for steam, exhaust, feed water and drain pipe work for Craven Street generating station. See "Official Notices" December 7th.

Blackpool.—December 17th. The Corporation wants tenders for the supply of arc lamp carbons and oils for one year. See "Official Notices" November 23rd.

Brighton.—The Council invites tenders for the supply of unarmoured and armoured lead-covered electric cables for one year. See "Official Notices" December 7th.

Bristol.—December 20th. The Electrical Committee wants tenders for induced draught plant, steam and electric pumps, and water-softening plant. See "Official Notices" November 30th.

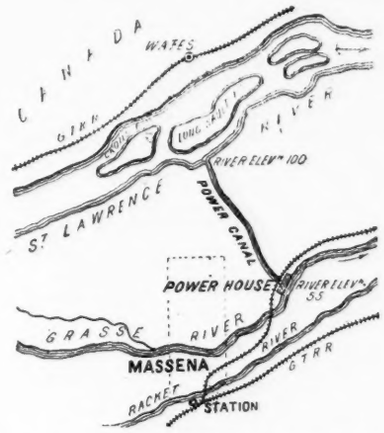
Copenhagen.—January 3rd, 1901. The Corporation invites tenders for three 530-kw. dynamos, switchboards, &c. See "Official Notices" November 23rd.

(*Continued on page* 951.)

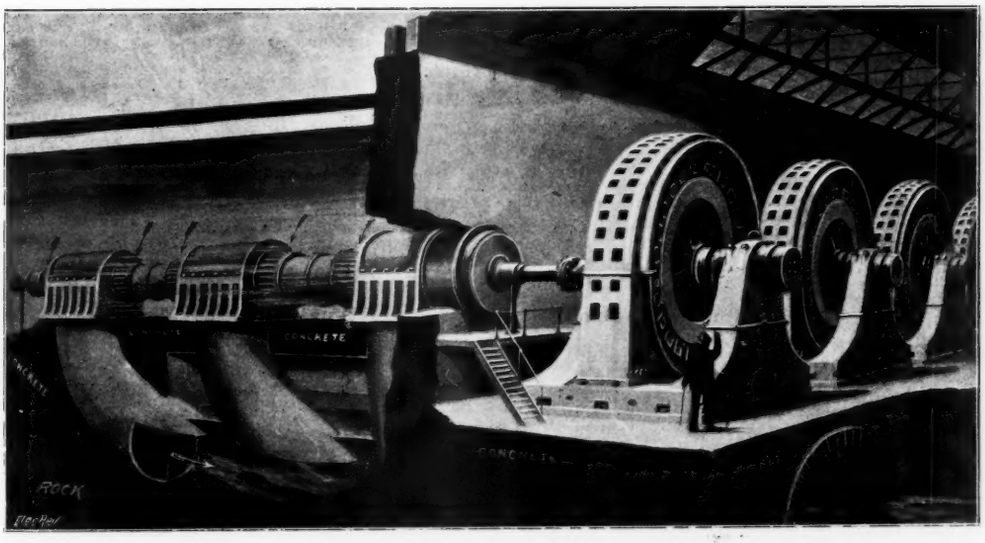
THE ST. LAWRENCE POWER COMPANY'S PLANT AT MASSENA, N.Y.*

There is nearing completion at the little town of Massena, N.Y., near the St. Lawrence River, one of the latest and largest of the hydraulic electric power plants, the development of which is one of the most significant features in the world of engineering at the close of the nineteenth century. The earliest of these was the installation of the Niagara Falls Power Company, at Niagara, of which we have at various times given very complete illustrations. This plant has a capacity at present of 50,000 H.P., and a second wheel pit is now being excavated which will exactly double the capacity. Another extensive plant for the utilisation of the waters of the Great Lakes is that which is being constructed at the Sault Ste. Marie Rapids, where works are in progress for the development of 60,000 H.P.

The ambitious undertaking which forms the subject of the illustration shown below, contemplates the development, ultimately, of 150,000 H.P., although the works at present in progress are designed for an output of 75,000 H.P., this being the capacity of the present canal. By a study of the accompanying plan of Massena and its surroundings, it will be seen that the natural conditions are remarkably favourable to the development of a scheme like the present one. For several miles in the vicinity of the Long Sault Rapids, in which the St. Lawrence River undergoes a fall of 50 feet, the Grasse River flows approximately parallel with the St. Lawrence at a distance of a few miles from the same, ultimately discharging into that river below the rapids. At the head of the rapids the level of the St. Lawrence is about 42 feet higher than that of the tributary stream, and advantage has been taken of this fact to cut a canal across the intervening country and utilise the head of water which is thus secured in a power plant located on the banks of the Grasse River, which is utilised as a tail-race for the discharged waters. The effective head above the Grasse River level at the power house is 35½ feet. As at present constructed, the canal has a surface width of 192 feet, and a depth of 18 feet. The present capacity of the whole scheme is limited by the capacity of Grasse River, which has sufficient sectional area to carry away the tail-race waters for a development of 75,000 H.P. When this point has been passed in the development of the scheme, dredging operations will be necessary in the Grasse River; but it will be possible, by dredging out the same and making full use of the capabilities of the canal, as ultimately enlarged, to produce a maximum of 150,000 H.P. The hydraulic electric plant which is now being erected at the power house will have a capacity of 37,500 H.P., and the extension which is immediately to be made will bring up the equipment to a total horse-power of 75,000.



Plan showing Location of the Massena Canal.



Power Plant at Massena.

By the courtesy of the St. Lawrence Power Company, a party made up of the representatives of technical journals of New York was recently taken down to Massena as guests of the Power Company, and driven over the work, every facility being extended by Mr. William F. Zimmermann, the general manager, and Mr. T. A. Gillespie, the contractor, of the St. Lawrence Power Company, for a thorough examination of the same. As a result of the very quiet manner in which this company has executed a work of this magnitude, sur-

F

* *Scientific American.*

at the General Post Office a deputation from Scotland to protest

(*Continued on page* 951.)

prise was expressed at the advanced stage to which it had been pushed. Of a total estimated excavation of 5,922,000 yards, 4,500,000 yards had been removed. The canal,

Fig. 1.

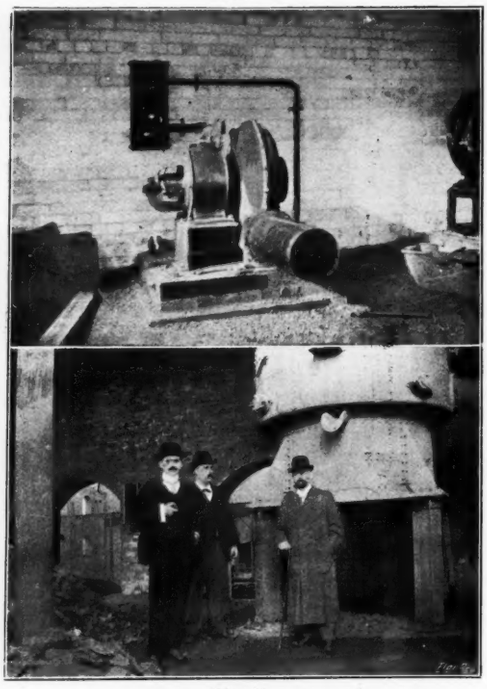


Fig. 2.

Blast Furnace Gas Power Installation.

which is about three miles in length, has been so far advanced, indeed, that it is likely to be ready for use during the spring of next year. The concrete work of the power house is completed and roofed in, and the work of installing the turbines and generators is being actively prosecuted.

The power house, which is being built upon the bed rock of the Grasse River, will ultimately be nearly 700 feet long, with a width of about 150 feet. The 15 6,000-H.P. turbines, or, rather, sets of turbines (each set consisting of six wheels) which will be here installed, are of the well-known Victor type. These turbines will be placed upon horizontal shafts in three sets of two wheels each. This is in marked contrast to the turbines at Niagara, which, with their corresponding generators, are mounted upon vertical shafts. The Niagara shafts are 150 feet in length, while the horizontal shafts at Massena are but 80 feet long. The six turbines of each set will develop power sufficient to operate one 5,000-H.P. generator. Such structural differences as there are between the two outfits are due to the difference in the character of the two water-ways, the fall at Massena being less, and the volume of water greater than at Niagara.

The power house will have a height of about 60 feet, giving ample head room for an 85-ton overhead electric travelling crane, which will run throughout the entire length of the power house. In addition to the 15 sets of turbines for driving the large generators, there will here be installed three smaller turbines, operating three direct current generators, to be used as exciters for the main machines. Direct current is required for exciting alternating current machines, and this may be furnished by a small direct current machine rotating on the same shaft with the large machine, or else separately driven. For the plant of the Power Company, as in practically all other large supply systems, separate exciters are provided, and in this case, as stated, they are operated on separate shafts, and by separate turbines.

Each of the enormous main generators, giving an output of 5,000 H.P., will weigh 175 tons. The generators will stand about 22 feet above the tops of the foundations, and each machine will measure on the ground 22 feet by 18. The generator shaft is a continuation of the shaft upon which one set of the turbines is mounted. This shaft carries the revolving field, which is in effect a huge steel wheel, 15 feet in diameter, and 3 feet wide, cast with 10 massive spokes. This field magnet is designed to rotate at a speed of 150 revolutions per minute, which gives a speed at the circumference of about $1\frac{3}{4}$ miles per minute. The wheel carries 20 externally projecting pole-pieces, and rotates within a large stationary ring built up of thin soft steel discs, held by a massive outside cast-iron yoke. These thin steel discs constitute the stationary element of the magnetic circuit of the generator. Along the inner face of the ring, which is thus built up, are provided slots, in which are laid the copper conductors of the armature. These copper bars are mica-insulated. The rotating wheel (which, with its projecting pole-pieces and copper windings, supplied with current from the separate exciting machines, forms the field magnet of the generator) induces an alternating current in the copper windings of the stationary outer ring or armature. It is this current which, at a pressure of 2,200 volts, will give an electrical output of 5,000 H.P. This current is carried to a main switchboard, the various machines being connected therewith by means of a set of massive copper bus bars.

The method by which the output of 75,000 H.P. will be controlled possesses unusual interest, on account of its simplicity. One man, by manipulating a series of electric buttons, arranged on a small stand, will be able to control instantaneously the whole output of 75,000 H.P. Running the length of the power house will be a raised platform, in the middle of which will be built a central controlling stand, made desk fashion, and semi-circular in shape, so that an engineer stationed at its centre will have within reach the controlling apparatus of the entire station. This controlling stand will carry a number of marble slabs or tablets (one for each generator), upon which will be mounted small controlling keys. These keys are arranged on the interlocking system, and they will operate, by means of local battery circuits, a series of compressed air valves and pistons. The latter will, in turn, control a series of 15 switching stands, one for each generator, equipped with the necessary cut-outs

Fig. 3.

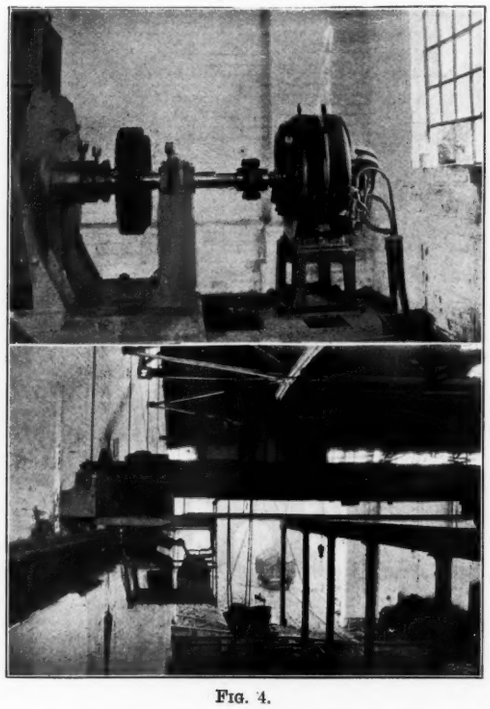


Fig. 4.

Blast Furnace Gas Power Installation.

and switches. The stand will be located under the raised platform, and approximately opposite its corresponding generator. Each stand will carry three-pole carbon shunt circuit-breakers, in series with which will be three-pole double-

throw switches. The circuit breakers and switches are controlled by means of compressed air, as previously stated, from the central controlling stand operated by the engineer. Stands similar to the switching stands are provided for the different outgoing circuits. The operator thus has under his eye at every moment the huge generators themselves, their

Fig. 5. Fig. 6.

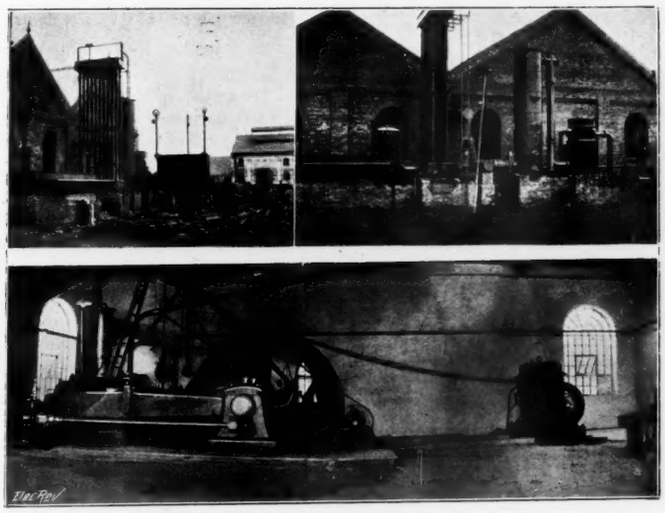


Fig. 7.

Blast Furnace Gas Power Installation.

corresponding switches and indicating instruments, and in reach of his fingers are the electric buttons, by means of which the entire plant is regulated and controlled.

The current thus generated will be used for a variety of purposes. It is adapted for use in operating induction motors, which, because of their ideal simplicity of construction and operation, are coming widely into use in place of the more delicate and complicated direct-current motor for general power service. It can be used for lighting and heating, and for electrolytic work, as well as in a great variety of electro-chemical processes, such as the manufacture of aluminium, calcium carbide, and other products which have been made commercially available only through the application of electric power at extremely low cost, as furnished by such means as the Niagara and St. Lawrence plants. For some of these purposes the high tension alternating current has to be transformed into low pressure direct current, and this is readily done with a very small loss, by means of the modern rotary converter.

Massena is an unusually good centre for such a purpose, as its facilities for transportation are excellent. The New York Central and Grand Trunk lines intersect here, and the Vermont Central Railroad and the New York and Ottawa Railroad come within a short distance of the town. Large lake vessels may be admitted to the Power Company's canal, thus affording direct communication by water with the lake system. If necessary, in the future, a lock may be constructed which will pass vessels from the canal into the Grasse River, and thence back into the St. Lawrence River. Such a plant as this affords ideal facilities for the transmission of the electric current over great distances, as is done from the central power plant at Niagara, but it is not the intention of the St. Lawrence Company to so transmit it, but rather to furnish the power at such low rates that manufacturing establishments will find a strong incentive to locate in the vicinity.

BLAST FURNACE GAS-POWER INSTALLATION.

At the Sheepbridge Iron Works, Chesterfield, the works manager, Mr. Herbert Pilkington, M.Inst.C.E., Past-President of the Staffordshire Iron and Steel Institute, recently inquired into the question of the utilisation of blast furnace gas, and with his usual prescience and enterprise, determined to adopt the Thwaite-Gardner system to provide the electric motive power in connection with a pipe foundry equipped in the most modern manner for economically turning out high class cast-iron pipes.

With the exception of some hydraulic apparatus, this foundry is dependent upon a gas engine, which, by means of a dynamo (fig. 7), provides the electric current for lighting, and for driving a Thwaites "Roots" blower (fig. 3), Sturtevant blower (fig. 1), travelling crane (fig. 4), loam mill, sand mixer, and other machinery by electric motors.

The gas employed in the engine is that given off from the blast furnaces, and treated in a Thwaite-Gardner installation, shown in figs. 5 and 6. The treatment plant is effective, and calls for very little attention.

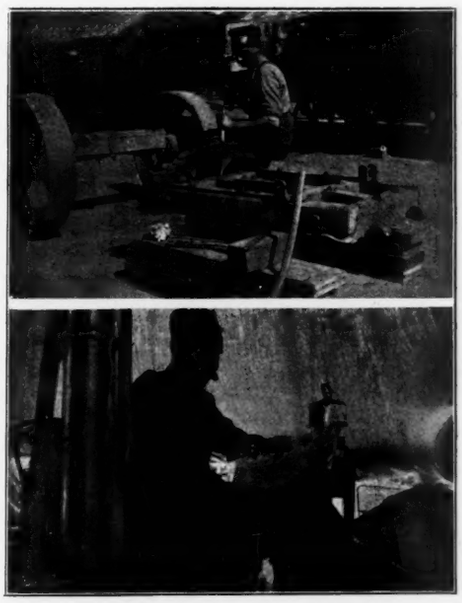
In this application the unit of 100 I.H.P. was decided upon, and provision made for future extension.

The gas engine is fitted with improvements, patented by the Blast Furnace Power Syndicate, for scavenging and ignition, which makes it a high-class motor; the efficiency at half load is said to have attained a higher figure than has hitherto been realised in any thermo-dynamic motor.

The success of the installation was dependent upon its being capable of continuous running, as, besides the crane and other motors, those motors supplying the air blast to the cupola (fig. 2) stoves and gas producers, have to run continuously during the operation of the foundry.

It will be apparent that the system must provide for the development of electrical energy continuously, and that the current must be generated with such regularity in voltage as to provide for both incandescent and arc lights, while at the same time subject to a very variable load.

All these qualifications have been so successfully attained that further generating units are now being installed to provide for an increase of the application of motors, and the extension of the Thwaite-Gardner system has been



1.

2.

1. E.Es. as wheelwrights; Sergt. Phillips chipping (at Pretoria).
2. Sergt.-Major Brown, R.E., in Sergeants' tent (Pretoria).

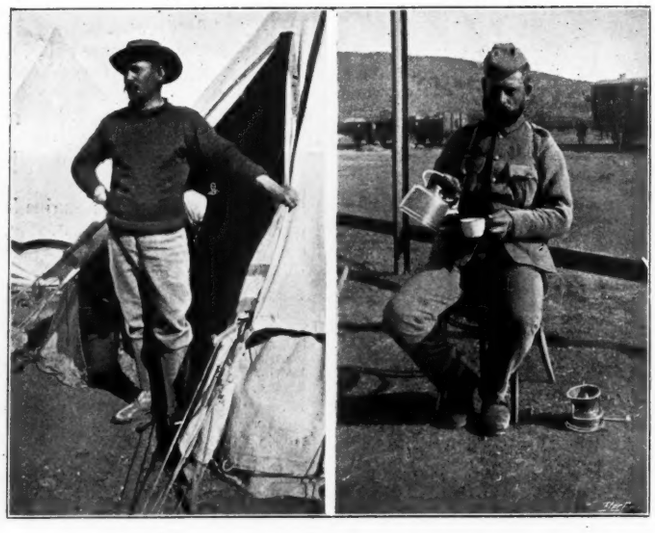
Electrical Engineers (R.E.) Volunteers.

The generator shaft is a continuation of the shaft upon

breakers, in series with which will be three-pole double-

decided upon after an examination of the systems in use on the Continent.

The electrical installation has been carried out by Messrs. J. H. Holmes & Co., who have laid the mains in culverts



3. Corpl. Edwards, R.E., noted for his culinary ski l (at Vaal River).

4. Sergt. Ruse, R.E., on light diet after his return from hospital.

Electrical Engineers (R.E.) Volunteers.

instead of carrying them overhead on posts.

The gas engine is of the single-cylinder improved Otto type, and is furnished with a heavy fly-wheel, a bearing being placed at the outer side of it to equalise the strains on the crankshaft.

The patented scavenging arrangement and ignition appliance permit of the maximum power being obtained from the gas with regular ignition, a timing valve of special design preventing premature explosions.

The gas engine and gas treatment plant are all under the charge of one man, and indicators are arranged in the engine room, showing clearly the condition of each part of the treatment apparatus; signal bells in connection with the pipe foundry render the attendant fully aware of the requirements for power, &c.

Besides those motors already in the foundry, others are to be put down in connection with a new blast furnace, equipped in the most modern Anglo-American style, for delivering the charges of ore, fuel, and flux by means of a tramway.

It will be evident from the above description that the power at these works will be obtained from the blast furnace gas at even less cost than if there chanced to be an available source of water-power at hand.

The photograph showing the gas treatment plant was taken just after erection, and that of the Sturtevant blower at a time when the pipe connection was disconnected.

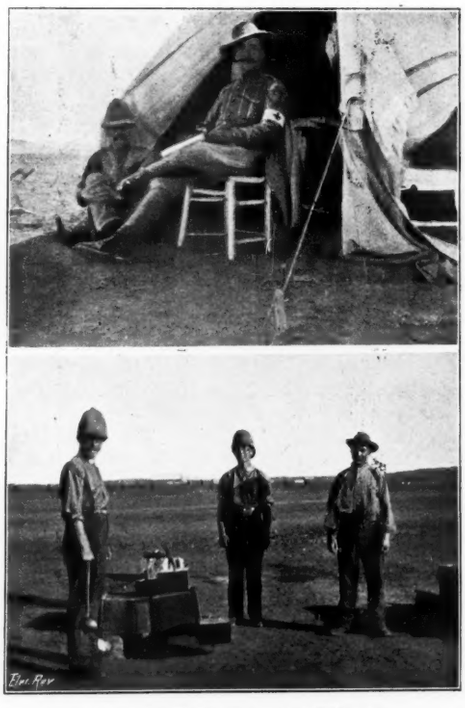
THE INSTITUTION OF ELECTRICAL ENGINEERS.

The discussion on the evenings of November 29th and December 6th over the problem submitted by Mr. W. E. Langdon in his paper "On the Supersession of the Steam by the Electric Locomotive," was, like the title of the paper, somewhat unwieldy, and bristled with figures, which do not lend themselves happily to condensation. Last week the hit of the evening was the contribution to the debate by Mr. Frank Sprague, just as a week before his English counterpart, Mr. J. S. Raworth, woke things up from a discussion resembling a page of Molesworth's Pocket-book.

The Burgdorf—Thun line was frequently referred to, and it is evident that engineers are keeping themselves much better informed of progress on the Continent than formerly. Perhaps we have to thank Dr. S. P. Thompson and the Swiss visit of the Institution for this. Mr. Langdon came in for criticism on the details of his paper, although he stated it was merely suggestive. Thus Mr. Mark Robinson raised the question of separate steam-driven stations in preference to one large station with sub-stations. The best reply was Mr. Swinton's, who carried the meeting with him when he argued that to ensure a steady load and economical generation a long length of railway line must be supplied from one centre.

It appeared to be generally felt that the case might have been put even stronger for electricity. On the other hand, many thought that the power required had been underestimated. On one hand, Mr. Robinson ventured to suggest that no great economies were obtained in materially increasing the size of engines or in adopting very large central power houses. On the other hand, Mr. A. A. C. Swinton saw no reason to limit the size, and urged the attendant economies in staff, buildings, and subsidiaries. Several railway men spoke; the engineers of the Central London Railway went into detail regarding coal consumption and tractive effort, but all these good things will be a feast in the *Journal*. We commend a careful study of the figures to all our readers when the discussion can be read at ease. We refrain from overloading them with too many statistics a week before Christmas.

Mr. Raworth expressed his delight at seeing Mr. Langdon once more, and while thanking him for the industry and perseverance represented by the paper, reminded the meeting that it was not the outcome of the inventor's fever. Professors must read papers or burst. This was an attempt to tap the pockets of financiers on behalf of electrical men. Mr. Crompton contributed one of the best serious speeches, and having referred to his work designing the Himalayan railway, said it showed at once why locomotive performances



5. Volunteer Medical Staff, at Springfontein.
6. Some more of the Volunteer Medical Staff.

Electrical Engineers (R.E.) Volunteers.

recently inquired into the question of the utilisation of blast

the extension of the Thwaite-Gardner system has been

are so poor, and why compound locomotives are questioned. The extraordinarily poor load factors of locomotives themselves disappear when supply is taken from fixed stations. Again, locomotive drivers must be skilled men: motor drivers may be paid much less and wages saved. Motors need not cost anything like locos. for repairs, and there are no boiler repairs. Further, locomotives cannot be built to give much more power, but with electric traction the power can be raised indefinitely. Mr. Hammond, after running over the history of electric lighting and power supply in brief, asked two questions. Is the plan of running full-gauge railways by electricity feasible? and, Are the estimates laid sound or not? He thought it might unhesitatingly be allowed to go forth to the world that the opinion of the Institution was that such railways could be run by electricity, and he cited some of the Continental lines being constructed by Schuckert and Ganz. He considered the estimates of working cost to be sound, and that a central station site had to be sought so that water was plentiful and coal taken to it at a cheap rate.

Further detail figures of railway working were submitted by Mr. F. Hudleston, Mr. A. H. Walton and others. The capital estimates in the paper were criticised more particularly by Mr. Swinton on the amount set aside for conductors, while Mr. A. J. Lawson wished to see the efficiencies of motors and transformers put at a better percentage than had been given by Mr. Langdon.

Mr. Alex. Siemens agreed with Mr. George Westinghouse in thinking that there is little chance of economic electric traction of long line trains. He was followed by Major Cardew on the same topic. The opinions expressed were in favour of rapid service of lighter loaded trains, and that the service should be suited to the new means of working. Shunting, coaling, and such like charges are largely avoided with electrical traction. Mr. Segundo followed up the argument, and suggested further that use should be made of the existing sources of electrical supply.

Mr. Sprague believed that electrical railways would not be conducted on steam methods, and considered that the electrical locomotive does not exist as one speaks of a steam loco. He pointedly criticised the rating of electric motors and the fictitious values given to large as compared with small. He showed that the loco. motor was restricted in space, and viewed the whole matter in the light of experience. He further pointed out the advantages of the multiple unit system.

Prof. Forbes alluded to some of his past work on the same subject, and criticised the author rather than the paper. Prof. Carus-Wilson dealt principally with how the non-productive branch lines of a railway could be made to pay, and gave an estimate of the increased revenue due to working under the best electrical conditions.

Mr. Langdon, in his reply, defended the choice of example selected for his paper, and made out a good case for its consideration by the Institution. He was, however, cut short by the President in his detailed answers to the various speakers, and we shall look for an interesting addendum to the paper when his full reply is published in the *Journal*.

CONTRACTS OPEN AND CLOSED

(*Continued from page* 946.)

France.—December 21st. Tenders are being invited until the 21st inst., by the French Post and Telegraph authorities for the supply of 583 tons of copper wire. Tenders are to be sent to Le Sous Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris, whence particulars may be obtained.

Harrogate.—December 25th. The Corporation wants tenders for two Lancashire boilers, with economiser and fittings. See "Official Notices" November 30th.

Hendon.—December 31st. The U.D.C. wants tenders for Lancashire boilers, stokers, pumps and economiser; two 150-kw. steam dynamos, motor transformer, &c.; condensing plant, crane, switchboard work, battery, mains, meters, and workshop equipment for electricity works. See "Official Notices" November 16th.

Leeds.—December 31st. The E.L. Committee invites tenders for two 1,400-kw. two-phase steam alternators and two sets of surface condensing plant. "*British manufacture.*" See "Official Notices" December 7th.

Leigh.—December 17th. The Electricity and Tramway Committee wants tenders for mains, and for 1,000 220-volt incandescent lamps. See two "Official Notices" November 30th.

Manchester.—December 22nd. The Tramways Committee wants tenders for the supply of tramway bonds. See "Official Notices" to-day.

Paraguay.—January 15th. The municipality of Asomption, Paraguay, is inviting tenders for the electric lighting of the town. Bond £600.

Partick.—January 7th. The Commissioners want tenders for steam dynamos, battery charging motor booster and balancer. See "Official Notices" to-day.

Rathmines.—January 10th. The District Council wants tenders for Lancashire boiler, 300-kw. steam dynamo, condensing apparatus and pipework, switchboard extension, mains, and public lighting (incandescent). See "Official Notices" November 30th.

St. Pancras.—December 20th. The Guardians are inviting tenders for the electric lighting of Cooks Terrace Infirmary. Clerk, Town Hall, Pancras Road.

Stavanger.—January 2nd. Tenders are invited by the Stavanger Corporation for the establishment of electrical communication or transmission of power from the Altesrig Waterfalls to Stavanger, a distance of about 39 kilometres, in accordance with the plans of a civil engineer named Schoien. Tenders must be received by January 2nd, 1901. Further information may be obtained on application direct to Mr. E. Berentsen, British Vice-Consul, Stavanger.

Swansea.—December 17th. Tenders are wanted for wiring and fitting the public library and other buildings. See "Official Notices" December 7th.

Swindon.—December 24th. The Corporation wants tenders for the supply of three high speed triple-expansion steam dynamos, balancer, and motor-generator for electricity works. See "Official Notices" November 30th.

Worthing.—December 31st. Tenders are wanted for a main switchboard. See "Official Notices" to-day.

Worthing.—December 31st. The E.L. Committee invites offers from those firms willing to equip and maintain electric tramways. See "Official Notices" to-day.

CLOSED.

Ayr.—The tender of Messrs. Hurst, Nelson & Company, Limited, Motherwell, for the construction of ten cars with complete electrical equipment has been accepted. The amount of tender being £5,673 10s.

Brighton.—The T.C. has accepted the offer of Messrs. Willans & Robinson to supply two triple-expansion engines coupled to 440-kw. dynamos similar in all respects to the last two sets supplied by them, for the sum of £9,698.

Cardiff.—Messrs. D. Bruce Peebles & Co. have just received an order from the Cardiff Corporation for one of their 200-h.p. traction balancing sets. It will consist of two standard multipolar machines coupled together with a fly-wheel between them, the whole mounted on one bedplate. The firm have also received an order from the same Corporation for a battery of Tudor accumulators, and a milking booster.

Darwen.—Messrs. D. Bruce Peebles & Co. have received an order from the Corporation for a 600-h.p. traction generator. The machine will be direct coupled to a high speed vertical engine of Messrs. Belliss & Morcom's make.

Hereford.—The T.C. has provisionally accepted the tender of the I. R., G. P. and Telegraph Works Company, for a 250-kw. steam dynamo.

Southport.—The Electricity Committee has accepted the tender of Messrs. Belliss & Morcom, Limited, to supply a triple-expansion 1,000-h.p. engine for £4,200, the tender of Messrs. S. Z. de Ferranti Limited, to supply a 600-kw. alternator for £2,500.

Watford.—The U.D.C. has accepted Messrs. Babcock and Wilcox's tender of £150 for a superheater, and £452 for steam connections and other work.

West Bromwich.—The Town Council have accepted the tender of the Alliance Electrical Company, Birmingham, for the supply of motors and switch gear for hiring.

FORTHCOMING EVENTS.

Friday, December 14th.—At 8 p.m. Institution of Mechanical Engineers, Storey's Gate, S.W. "Power Gas and Large Gas Engines for Central Stations," by H. A. Humphrey, Northwich.

At 5 p.m.—Physical Society. At the Physical Laboratory of the Royal College of Science, Exhibition Road, South Kensington (by invitation of Prof. Rücker):—"Electric Inertia," by Prof. A. Schuster, F.R.S.; "The Effect of Inertia on Electric Currents in a Rotating Sphere," by Prof. A. Schuster, F.R.S.; "Exhibition and Description of a Quartz-Thread Gravity Balance," by Prof. R. Threlfall, F.R.S.; "On the Theory of Magnetic Disturbances by Earth Currents," by Prof. A. W. Rücker, F.R.S.; "Notes on the Practical Application of the Theory of Magnetic Disturbances by Earth Currents," by Dr. R. T. Glazebrook, F.R.S.; "The New Physical Laboratories of the Royal College of Science," by Prof. A. W. Rücker, F.R.S.

At 8 p.m.—Institution of Junior Engineers. At the Westminster Palace Hotel. Paper on "The Metallurgy of Tin," by Mr. J. H. Davy James.

Monday, December 17th.—At 8 p.m. Society of Arts, Cantor Lectures. "Electric Oscillations and Electric Waves," by Prof. J. A. Fleming, M.A., D.Sc., F.R.S. Four lectures. Lecture IV.—"Electric Waves." Hertz's discoveries—Production of electric waves—Experimental study of their properties—Electro-optical phenomena—Reflection, refraction, absorption, and polarisation of electric waves, and apparatus for their detection and measurement.

Tuesday, December 18th.—At 8 p.m. The Institution of Civil Engineers. Ordinary meeting. Papers to be further discussed:—(1) "The Signalling on the Waterloo and City Railway," and (2) "Note on the Signalling of Outlaying Siding Connections," by Alfred Weeks Szlumper, M.I.C.E.; (3) "Signalling on the Liverpool Overhead Railway," by Stephen Butler Cottrell, M.I.C.E.

Thursday, December 20th.—At 8 p.m.—Institution of Electrical Engineers. A lecture will be given by Lieut.-Col. Crompton, E.E. (R.E.), past president, "On the Electrical Engineers (R.E.) in South Africa." (Lantern Views.)

At 7.30 p.m.—University College, St. Stephen's Green, Dublin. Institution of Electrical Engineers. Paper by Rt. Rev. Monsignor Molloy, D.D., D.Sc., "On Electric Currents of High Tension and Great Frequency, with Suggestions as to the possible Electric Light of the Future."

NOTES.

The Explosion at St. Helens Alkali Works—After nearly four days' hearing there was concluded at Liverpool Assizes on 11th inst., before Mr. Justice Bucknill and a special jury, an action in which the St. Helens Corporation, Lancashire, sought to recover £5,000 from the United Alkali Company, Limited, for injury done to the plaintiffs' gasworks by the wrecking of a gasholder and other erections caused by an explosion of chlorate of potash on defendants' works at St. Helens on May 12th, 1899. Five people were killed and 40 injured as a result of the explosion. The jury, who (says a Birmingham paper) were not asked to consider the question of damages, returned a verdict for the plaintiffs, finding that defendants ought to have known that chlorate of potash was explosive when unmixed with other substances; that defendants did not take all reasonable care and precaution to prevent accident by fire or explosion; that such want of precaution contributed to the explosion, and that the fire was not a chance one without negligence. Judgment was deferred.

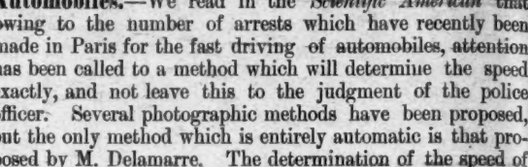
Fires.—The daily press reports that the Calais submarine cable and insulation factory of the Société Industrielle des Téléphones has been destroyed by fire. It is stated that the factory had been making telephone cables for the London National Telephone Company, and was about to begin preparing two cables for Indo-China. We are glad to learn that the damage to the works is much less serious than was at first expected. The repair work at the factory will be effected in the space of three or four weeks, and in the meantime all standing orders are being executed at the Company's works at Bezons, near Paris.

A New York press telegram says that the Brooklyn electric tramway power house has been totally destroyed by fire, but as the loss is estimated at only $200,000, there is doubtless an error somewhere.

Photographic Method of Determining Speed of Automobiles.—We read in the *Scientific American* that owing to the number of arrests which have recently been made in Paris for the fast driving of automobiles, attention has been called to a method which will determine the speed exactly, and not leave this to the judgment of the police officer. Several photographic methods have been proposed, but the only method which is entirely automatic is that proposed by M. Delamarre. The determination of the speed of a moving object depends upon the measure of the space passed over in one second; if V is this speed and E the space passed in T seconds,

$$V = \frac{E}{T}.$$

Suppose an apparatus provided with a shutter and an arrangement for obtaining upon the same plate two successive images at the interval of one second, the displacement of the image would permit of measuring the space passed over.



The fundamental formula for lenses would then give, according to the diagram,

$$\frac{E}{e} = \frac{P}{P'} = \frac{P - f}{f},$$

where f is the focal length of the lens used; whence

$$E = e\,\frac{P - f}{f}.$$

If E is known, the value of V will be at once obtained. The problem then consists in measuring E. M. Delamarre has already shown that if in operating from the same position two lenses of different focus are used, f and f_1, giving for the measure of E the values e and e_1, then

$$E = (f - f_1)\,\frac{e\,e_1}{e\,f_1 - e_1\,f}.$$

This formula is independent of the distance at which the operation is made. It suffices then to construct a hand apparatus of the detective form with coupled shutters, whose two lenses will have different focal lengths. The operator will then make the exposure, and the plate when developed will be measured and the above formula applied, thus indicating at once the speed of the vehicle in question. An apparatus of this kind would fulfil the conditions required; it is necessary, however, before reducing the idea to practice, to overcome a number of difficulties, and the originator of the device is at present working in this direction. The difficulties, which are inherent in any apparatus of the kind, are that it is necessary to operate upon a portion of the path of the automobile which is perpendicular to the axis of the lens, and besides a lens with fixed focus must be used. It is, however, quite possible to construct an instrument of this kind of an entirely practical nature.

American Society of Mechanical Engineers.—This Society has just held a four days' convention in New York. The presidential address, delivered by Mr. C. H. Morgan on December 4th, opened the proceedings, and among the papers read were the following:—

"Comparison of Rules for Calculating the Strength of Steam Boilers," by H. de B. Parsons; "A Record of the Early Period of High Speed Engineering," by Chas. T. Porter; "Steam Engine of Maximum Simplicity and of Highest Thermal Efficiency," by Robt. H. Thurston; "The Construction of Contracts," by Reginald P. Bolton; "An American Central Valve Engine," by E. T. Adams; "Apparatus for Dynamically Testing Steam Engine Indicators," by Carleton A. Read; "Comparative Value of Different Arrangements of Suction Air Chambers on Pumps," by F. Meriam Wheeler; "Tests of Centrifugal Pumps," by W. B. Gregory; "New Principle of Gas Engine Design," by Chas. E. Sargent; "Heat Efficiency of the Gas Engine as Modified by Point of Ignition," by C. V. Kerr; "Power and Light for the Machine Shop and Foundry," by Forrest R. Jones.

The International Exhibition of Fire Prevention, Fire Extinction, and Fire Escape Apparatus at Berlin in 1901.—The business committee of the above undertaking held its fourth sitting on November 26th, at the Post Office, Berlin, under the presidency of the Secretary of the Post Office, Von Podbielski. The report read showed that ample support had been promised by both home and foreign manufacturers and others. Allied departments will be fully represented, such as the yoking and care of horses; office and barrack arrangements; first aid for men and animals; protection against flooding, especially in mines; fire escape arrangements for hospitals, lunatic asylums and prisons; street cleaning and paving; removal and utilisation of dust; fireproof building and heating arrangements; chimney sweeping; precautions against fire in buildings of all kinds, especially for theatres and for electric installations; lightning conductors; insurance; benefit schemes for firemen; gymnastics; finally, art and literature as far as they have any bearing on the branches of industry above mentioned. Many firms have applied for large spaces, and will erect special pavilions. From abroad many interesting exhibits have been promised; for instance, two large steam fire engines have been promised from Stockholm. Numerous Governments, the Prussian, of course, taking the lead, have offered for competition prizes, and gold, silver and bronze medals. Most of the home and foreign railways have offered free carriage of goods to and from the Exhibition; as have also the North German Lloyds, the Hamburg-American, and many other shipping lines. Goods for the Exhibition are admitted into Germany duty free, duty being charged only in case of a sale. In Austria, Switzerland, France, Russia and other countries trips to see the Exhibition have been arranged for the fire brigades. In connection with the opening of the Exhibition a general fire brigade congress will be opened under the auspices of the Grand Conseil International de Sapeurs-Compiers. Detailed reports will be made by the committees of all sections and sub-sections, with the assistance of the most eminent experts in Berlin and other places. Experiments and practical exhibitions will be shown in a field set apart for the purpose. All information about the Exhibition can be obtained by applying to the office, 41, Lindenstrasse, Berlin, S.W.

Transition to Electric Power.—Mr. Alton D. Adams contributes some notes of considerable interest to *Cassier's Magazine*. They are worth more than passing interest, because they draw attention to an unexpected phase of the subject of electrical transmission. He points out that whereas it was anticipated that power would be conveyed long distances to works, the opposite has proved to be the case, and long distance transmission seems likely to be of small growth, while there will be great increase in short distance transmissions. Hitherto, the use of a water-power has been confined to such a number of factories as could be built round about the waterfall. This area was naturally limited, and with large falls much of the power went to waste for lack of room to build enough factories to use the power. To some extent the wire-rope system of transmission served to spread factories, and left mill sites to be occupied solely by the turbines. But this system had not much growth. Electrical power offers the same chance with less complication. All the ground around a fall can be occupied by power houses only. This prevents the enormous rents of the old mill sites. Mill sites can be anywhere within transmission distance, and it is found that practically the power is used on short distance transmissions only, that industries have travelled long distances to be near power, and that power has not been carried to the industries. It has, in the author's words, been found more economical to move an industry once than to move a lot of energy a long way daily. Further, transmission lines are costly, and it is something to save their first cost and subsequent interest charges and line losses. The length of a transmission line appears likely to be governed by the available sites near a waterfall, and it must be a very large fall that has not an area for sufficient sites within a small radius. Obviously where a waterfall is in a bad location, as among the mountains, it is probable that the factory locations will be put down in the valleys.

Just as, years ago, industries in America moved to the natural gas areas, so now they tend towards water powers. In a country like the United States, the severe winter will always act as a deterrent in certain industries and for certain water powers. Niagara does not freeze up, and it should always be possible to get a flow of water to the turbines. But frost may render smaller falls unmanageable in winter, and the question of an engine as standby crops up and must be considered with all that is implied in the way of charges on idle plant and double capital. The concentration of power at Niagara is already being duplicated on a smaller scale at other falls. It is probable that with the larger areas of ground available for the generation of power at a fall owing to the removal of the factories themselves from the immediate locality, a better provision can be made in regard to such falls as do not freeze dry for securing water to the wheels in more sunk and protected pits. It would be interesting to have some description of such means as may have been taken to secure this desirable end.

The Röntgen Society of the United States.—This Society to-day closes its two-day conference at New York City. The papers being read are as follows:—

THURSDAY, DECEMBER 13TH.

"The Development of the X Ray Plate," by Dr. J. N. Scott.
"Application of Röntgen Rays to Dentistry," by Dr. C. Edmund Kells, jun.
"The First Legal Victory of the X Ray Shadow as seen by the Iowa Jury" (illustrated), by Dr. F. Wesley Sells.
"A Review of Cases of X Ray 'Burns,'" by Dr. E. A. Florentine.
"X Light Apparatus for Physicians in the Country," by Dr. William Rollins.
"On Diagnosticating Ostitis, Osteomyelitis, and Osteosarcoma by the Röntgen Rays," by Carl Beck.
"The Monell Position Finder for Centering Skiagrams," by Dr. S. H. Monell.
"Skiagraphy in Oral and Dental Surgery" (illustrated), by Weston A. Price, D.D.S.M.E.
"Practical Work with the Static Machine and Vacuum Tube," by Dr. J. M. G. Beard.
"X Ray in Lupus Vulgaris, M.U.," by D. Jos. Hoffmann, Vienna.
"The Electro-chemic Action of the X Ray in Tuberculosis," by Dr. J. Rudis-Jicinsky.
"Demonstration of the Mount Bleyer Electro-arc Chromolinne for the Treatment of Tuberculosis by Coloured Light Rays," by Dr. J. Mount Bleyer.
"Indications for General Franklinisation, Report," by Prof. A. Tripier, M.D., Paris.

FRIDAY, DECEMBER 14TH.

"How to Print the X Ray Picture for Details," by Dr. John T. Pitkin.
"Standard Pictures in Skiagraphy, and how they may be Secured," by Dr. L. A. Weigel.
"The Monell X Light Standardising Gauge and Fluoroscope Test," by Dr. S. H. Monell.
"The Technique of the X Ray Work," by Dr. Mihram K. Kassabian.
"Stereoscopic Skiagraphy," by Dr. L. A. Weigel.
"General Observations on Crookes Tubes," by H. Westbury.
"Amplifying and Parallelising X Rays," by Prof. Elmer Gates.
"Stereoskiagraphy," by Dr. G. P. Girdwood.
"Demonstration of Skiagraphs of Injuries at the Elbow Joint at time of Injury, and the Gradual Repair of Same, successive Skiagraphs," by Dr. A. H. Schwab.
"Technique of Skiagraphy," by W. C. Fuchs.
"A Demonstration of Electrolytic Interrupters," by E. W. Caldwell.
"The Monell Distortion Landmark for X Ray Negatives," by Dr. S. H. Monell.

The Electro-Harmonic Society.—The smoking concert on Wednesday evening was perhaps not so largely attended as might have been expected, but the excellent programme was, on the whole, successfully carried out. The violoncello and pianoforte duet by Messrs. Parker and Izard, we need hardly say was very finely rendered, and Mr. Izard's pianoforte solo, "The Wedding Day at Tröldhangen," was very bright and agreeable. Mr. B. H. Groves, "She Alone Charmeth my Sadness," from *Irene* (Gounod), was very good, but his "Life that lives for you" (Sullivan) could hardly be regarded as a good specimen of Sullivan's songs. Mr. B. P. Parker's violoncello solo ("Nocturne") was excellent and artistic, and his "Carprice Hongroise" was likewise charmingly played. Mr. John Proctor's humorous "Word on Temperance" secured an encore, and Dr. Byrd Page's exceedingly clever sleight-of-hand illusions were generally admired.

Personal.—Mr. Arthur Ellis, who a short time ago left Bolton to become tramways electrical engineer to the Cardiff Corporation, has been also appointed to the position of electric lighting engineer at Cardiff on the departure of Mr. Appelbee for Ashton. Mr. Ellis was last week appointed engineer to the Electric Lighting Committee and electrical engineer to the Tramways Committee at a salary of £750 per annum, with an increase of £50 per annum for five years. Mr. Ellis has our congratulations, and we sincerely trust that during the next year or so he will succeed in placing the Corporation undertakings on a thoroughly workable and satisfactory basis.

Mr. S. E. Britton, who is leaving Barking for Motherwell, has been presented by his friends at the Barking electricity works with a handsome dressing case.

Mr. J. W. Pember, chief assistant electrical engineer to the York Corporation, has been appointed chief electrical engineer to the borough of Farnworth (Lancashire).

Mr. G. M. Harriss, late electrical engineer to the Bray Corporation, was entertained at the Royal Hotel, Bray, on Tuesday last week, and presented with an illuminated address and a purse of sovereigns, on his departure to assume the duties of representative in Ireland of Prof. Forbes.

Mr. W. A. Chamen, the city electrical engineer at Glasgow, recently received an offer of £1,250 per annum with a share of the profits from a large electricity supply company. The Glasgow Corporation has now, however, increased his salary from £800 to £1,000 per annum. This was the salary which Mr. Chamen asked for when he applied for the position at Glasgow. In spite of the above tempting offer Mr. Chamen will remain at Glasgow, and in view of the present position of the works there the electricity undertaking will be greatly benefitted. We congratulate both Mr. Chamen and the Glasgow Corporation.

Mr. Arthur R. Fearnley, manager of the Bradford and Shelf Tramways Company, has been appointed electric tramways manager to the Birkenhead Corporation.

The *Review of the River Plate* says that the Council of the Institution of Electrical Engineers of England have resolved to nominate a local honorary secretary in Argentina, and Mr. Ernesto Danvers has been asked to accept the same. Up to the present Uruguay and Argentina have been under one secretaryship, but in view of the large number of electrical engineers in Argentina it was lately decided to separate the two countries.

Mr. A. H. Seabrook, assistant engineer at the Hampstead electricity works, has been appointed engineer and manager to the Barking electricity works. He will take up his duties in a month's time.

Mr. George W. Grosset, of Edinburgh, has been appointed junior assistant at the Leith electricity works.

Fatalities in a Cable Storage Tank.—Two men, named Henry Carr, 60, and Richard Thornton, 32, were suffocated in a tank at the Telegraph Construction and Maintenance Works, East Greenwich, on Saturday night. The evidence at the inquest held on Wednesday showed that Carr descended into the tank, which was used for the storage of cables, apparently to adjust the plug at the bottom. He was at once overcome by gas which had been generated by the action of water on the covering of the cable. Thornton went to his assistance, and was also overcome. Other men, named Smoker, Bryan, Harris, and Rice, made gallant attempts at rescue, and the first-named was removed to the hospital in an unconscious condition. Carr and Thornton were got out by Rice, but all attempts at resuscitation failed. Mr. Lucas, manager at the works, eulogised the bravery of the men named, and said the firm were proud of them. The coroner and jury concurred. The *Times* states that the inquiry was adjourned for further evidence till December 31st.

The B.A. at Glasgow.—It is stated that the Council of the British Association have resolved that after the Glasgow meeting next year there will be only such excursions as may be organised unofficially.

Next Year at Glasgow.—There seems to be every prospect of the Glasgow Exhibition of 1901 being a great success. Those manufacturers who held aloof from the Paris Exhibition this year are almost sure to take advantage of the Glasgow show next year. The engineering and electrical trades will be certain to play a most important part—in fact, next year will be quite a Glasgow year for electrical engineers, what with Municipal Electrical Association and Institution of Electrical Engineers and B.A. conferences, engineering congresses, completion of the multiphase tramways, and the Exhibition. The London Committee met at the Mansion House on Wednesday under the presidency of the Lord Mayor, and judging from the speeches then delivered, it looks like being a satisfactory show, at which the English electrical manufacturer should be strongly represented.

Appointments Vacant.—The Stockport Tramways Committee wants a clerk of works for permanent way construction. A tramways manager at £350 per annum is wanted by the Burnley Corporation. A shift-engineer is wanted at Bexhill. An inspector is wanted for an electric lighting installation in a public building at Edinburgh. A mains foreman is wanted for Bermondsey. A junior assistant engineer is wanted for the Wimbledon electricity works. The salary for the Perth resident electrical engineership is £200 per annum, not £300, as stated last week.

Niagara Falls.—The Niagara Falls Power Company has awarded the General Electric Company, of Schenectady, N.Y., the contract for the construction of six dynamos, which are to be installed in the new power house to be erected over the wheel-pit now in course of construction. These six dynamos will be the initial installation in the new central station, and their output capacity will be 30,000 H.P. All the dynamos in the present power house of the Niagara Falls Power Company were built by the Westinghouse Company, and the contract was captured by the General Electric Company in competition. So far as the new machines are concerned, they will have the same general appearance and characteristics, but they will possess certain features that are expected to be advantageous. When they are completed they will be installed with all possible rapidity, in order that a full supply of current may be ready for the Pan-American Exposition. It was a year ago on Monday, November 12th, that ground was broken for the new wheel-pit now in building. In all ways the work has progressed satisfactorily, and the present depth of the pit is about 120 feet, whereas the pit will be 180 feet deep when finished.

Brescia.—A New Electrical Industry.—The *Tribuna*, of November 29th, states that after repeated trials with a furnace of 150 H.P. for smelting iron by electricity, a furnace of 500 H.P. has now been installed for the production of iron, steel, and other metals, direct from the ores. The process is the invention of Captain Stassano, of Rome, and the experiments were conducted before a commission composed of Signori Arno, of the Polytechnic of Milan; Del Lungo, of the Institute of Spezia; and Engineer Siracusa, Director-General of the Italian Electric Company, of Turin.

The National Physical Laboratory.—The Queen has granted to the Royal Society Bushey House, Bushey Park, for the purposes of a National Physical Science Laboratory.

Cardiff Castle.—Lord Bute's Welsh seat is likely to be lighted by electricity. Application has been made for terms to the authorities.

Lecture.—On Tuesday, December 11th, an address on "Electric Driving," was delivered by Mr. Robert O. Ritchie (Messrs. Greenwood & Batley) in connection with the Yorkshire College Textile Society, Leeds.

NEW COMPANIES REGISTERED.

South Lancashire Electric Traction and Power Company, Limited (67,974).—This company was registered on November 29th, with a capital of £850,000 in £1 shares, to acquire the business of the Lancashire Light Railways, Limited, and the South Lancashire Tramways Company, or all or part of the shares or debentures of such companies, to adopt an agreement with J. B. Atherton and J. Atherton, and to carry on the business of tramway, railway and omnibus proprietors, carriers, &c., and to equip, maintain, and work by electricity or otherwise any tramways and railways belonging to the company. The first subscribers (each with 1,000 shares) are:—Sir John A. Willox, M.P., Parkside House, Huyton, near Liverpool, newspaper proprietor; the Hon. Arthur Stanley, M.P., Knowley Hall, Prescot, Lancashire; Edmund K. Muspratt, Seaforth Hall, Seaforth, near Liverpool, J.P.; James B. Atherton, Manhattan, Gateacre, near Liverpool, manufacturer; Joseph Beecham, Ewanville, Huyton, near Liverpool, J.P.; Jacob Atherton, Hurst Park, Prescot, Lancashire, gentleman; and the Hon. George Stanley, Knowley Hall, Prescot, Lancashire, Captain. The number of directors is not to be less than five nor more than twelve; the first are Sir John A. Willox, the Hon. Arthur Stanley, E. K. Muspratt, James B. Atherton, and Jacob Atherton; qualification, £1,000; remuneration, £250 each per annum (£400 for the chairman), and a share in the profits.

Northern Counties Electricity Supply Company, Limited (67,924).—This company was registered on November 26th, with a capital of £200,000 in £1 shares, to supply electricity for the purposes of light, heat, traction, telephonic and telegraphic services, or any other public or private purposes within the United Kingdom, and to carry on the business of electricians, mechanical and electrical engineers, manufacturers of electrical apparatus, &c. The first subscribers (each with one share) are:—John D. Milburn, Barnhill, Asklington, Northumberland, shipowner; Clement W. Fairweather, 45, Grosvenor Place, Newcastle-on-Tyne, engineer; Charles S. V. Brown, 94, West Parade, Lincoln, electrical engineer; Herbert C. Harvey, 57, Westgate Road, Newcastle-on-Tyne, solicitor; James Patterson, 6, Jesmond Vale Terrace, Newcastle-on-Tyne, secretary; Arthur Scholefield, 2, Lovaine Row, Newcastle-on-Tyne, shipowner; and Stanley Mitcalfe, 60, Percy Park, Tynemouth. The number of directors is not to be less than three nor more than eight; the first are to be appointed by the subscribers; qualification, £250; remuneration as fixed by the company.

Cumberland Construction Company, Limited (68,007).—This company was registered on November 30th, with a capital of £10,000 in £100 shares, to further the construction, equipment, extension, and development of tramways, tramroads, and light railways, to establish, promote, and finance companies for similar purposes, to acquire powers, concessions, Orders and Acts of Parliament, and to carry on the business of tramway, tramroad, and light railway contractors and proprietors, builders of stables, electric, water, and other works, factories, and conveniences, &c. The first subscribers (each with five shares) are:—G. Flett, 110, Cannon Street, E.C., contractor; T. D. Lingard, 10, Booth Street, Manchester, solicitor; A. L. Ormrod, 10, Half Moon Street, Manchester, stockbroker; T. S. Turnbull, 13, Spring Gardens, Manchester, solicitor; J. Kerr, 94, George Street, Edinburgh, contractor; A. Dickinson, Telephone Buildings, Birmingham, electrical engineer; and E. Horton, The Grange, Bescot, Staffs., manufacturer. The number of directors is not to be less than two nor more than five; the first are George Flett, Thomas D. Lingard, Alexander L. Ormrod, and Thomas S. Turnbull. Registered office, 13, Spring Gardens, Manchester.

Paterson, Cooper & Co., Limited (4,692).—This company was registered in Edinburgh on November 30th, with a capital of £20,000 in £1 shares, to take over, acquire, carry on, and develop the business of electrical engineers and contractors now carried on by Paterson, Cooper & Co. at Paisley. The first subscribers (each with one share) are:—Paul Rottenburg, 105, West George Street, Glasgow, merchant: Robert Paterson, Springfield, Paisley, manufacturer; Wilfrid Marshall, Patilla Works, Paisley, electrical engineer; Louis Rottenburg, Patilla Works, Paisley, electrical engineer; W. S. Marshall, Patilla Works, Paisley, electrical engineer; Charles Ker, 115, St. Vincent Street, Glasgow, chartered accountant; Warren Crosbie, 141, St. Vincent Street, Glasgow, solicitor; and Robert Cassels, 6, Princes Gardens, Dowanhill, Glasgow, iron merchant. The number of directors is not to be less than three nor more than seven; the first are Andrew McClelland, Robert Cassels, W. Marshall, and Louis Rottenburg; qualification, £200; remuneration, not less than £50 each per annum. Registered office, Patilla Works, Paisley.

Crown Electric Heating Syndicate, Limited (67,987).—This company was registered on November 29th, with a capital of £5,000 in £1 shares, to adopt an agreement with A. R. Leask and H. Stewart, and to manufacture and deal in electrical appliances for heating liquids, and to carry on the business of electricians, electrical and general engineers, suppliers of electricity for light, heat, power, or other purposes, &c. The subscribers (each with one share) are:—A. P. Bebrouth, 41, Woodhouse Grove, East Ham, traveller; H. Auerbach, 2, Rosemount Mansions, Lithos Road, N.W., clerk; J. W. Wallsgrave, 11, Mint Walk, Croydon, clerk; A. F. Sims, 72, Eaton Terrace, S.W., articled clerk; C. L. Constantinidy, Hardwick Villa, Highgate, N., merchant; A. M. Pratt, 5, Grand Parade, Green Lanes, N., clerk; and H. Stewart, 76, Regent Street, W., accountant. The number of directors is not to be less than two nor more than five; the first are to be appointed by the subscribers; remuneration according to profits. Registered office, 15, Bury Street, St. Mary Axe, E.C.

Higginbottom & Mannock, Limited (68,004).—This company was registered on November 30th, with a capital of £60,000 in £1 shares, to acquire and carry on the business of engineers, millwrights, and hoist and crane makers, now carried on by L. Higginbottom, T. Mannock and E. Broome, at the Crown Iron Works, Fenton Street, Hyde Road, West Gorton, Manchester, under the style of "Higginbottom & Mannock," and to carry on the business of electrical engineers, electricians, chemical and medical apparatus manufacturers, &c. The first subscribers (each with one share) are:—L. Higginbottom, Hill Top, Cheadle Hulme, engineer; T. Mannock, Derwent House, Heaton Moor, near Stockport, engineer; E. Broome, 13, Birch Lane, Longsight, Manchester, engineer; J. B. Bowler, 1, Woodlands, Victoria Park, Manchester; H. H. Broome, M.D., 13, Birch Lane, Longsight, Manchester; G. Makin, 58, Strude Hill, Manchester, jeweller; and J. Makin, Sunny Bank, Vine Road, Didsbury. The number of directors is not to be less than three nor more than five; the first are L. Higginbottom, T. Mannock and E. Broome; qualification, £500. Registered office, Crown Iron Works, Fenton Street, Hyde Road, West Gorton, Manchester.

British Electric Railways, Limited (67,058).—This company was registered on December 4th, with a capital of £100 in £1 shares, to carry on the construction and maintenance of electric and other railways and tramways, and their accessories and appurtenances. The first subscribers (each with one share) are:—A. T. Prudey, 28, Castle Street, Kingsland, N., clerk; A. W. Hoale, 116, Craven Park Road, Harlesden, clerk; C. A. Whiting, Finchley Park, N. Finchley, N., registrar; H. Bearl, Plum Tree Cottage, Eve Road, Islesworth, secretary; J. Likeman, 50, Effingham Road, N., clerk; J. Gladwin, 40, Holborn Viaduct, E.C., housekeeper; and D. J. Norris, 61, London Street, Fitzroy Square, W., clerk. Registered without articles of association.

Hillgrove & Armidale Electrical Corporation, Limited (68,118).—This company was registered on December 6th, with a capital of £70,000 in £1 shares, to adopt an agreement between the International Railway Corporation, Limited, of the first part, and the company of the second part, for the sale of the undertaking described as the Hillgrove & Armidale Water Power Electric Company, and an assignment between the same two parties of the first two parts, and Crompton & Co., Limited, of the third part, of an agreement providing for the local management thereof, to acquire the benefit of certain powers granted by the Legislature of New South Wales, to carry on in the County of Sandon, and elsewhere in Australia, the business of an electric light and power company, to facilitate the navigation of the River Gyra, and to carry on the business of electricians, mechanical and electrical engineers, &c. The first subscribers (each with one share) are:—C. F. Truefitt, 10, Brooksville Avenue, Brondesbury, N.W., accountant; J. Trustham, 115, Colworth Road, Leytonstone, accountant; W. G. Bovey, 9, Benbow Road, Hammersmith, clerk; W. G. Heatlie, 22, Howard Road, Cricklewood, secretary; S. W. Money, 12, Hampstead Road, Walthamstow, secretary; J. Doloughan, 59, Regency Street, Westminster, clerk; and D. H. Wiseman, 194, Gresham House, E.C., managing clerk. The number of directors is not to be less than three nor more than eight; the first are to be appointed by the subscribers; qualification, £500; remuneration, £100 each per annum, and £50 extra for the chairman.

SUPPLY STATION ACCOUNTS.

Leyton Urban District Council Electricity Accounts.

The second set of accounts signed by Mr. F. Harman Lewis relating to the electricity works at Leyton unfortunately do not present altogether satisfactory features on the financial side. Almost exactly a year ago we dealt with the accounts for 1898, and then said "There is every indication that this deficiency (*i.e.*, the net deficit in the profit statement) can only be met by charging a price higher than that so far asked. One may say that, like other undertakings of similar size, the Leyton supply has attempted to create a quick and large demand by charging an inadequate price." These remarks stand to-day, and are substantiated by the accounts before us. We set out a summary of the figures for the past three years to show what is meant:—

Year.	Units.	Works cost.	Total cost.	Gross average receipts.	Gross profit.	Net profit.
1897	... 123,797	2·05d.	2·59d.	3·49d.	£466	−£737
1898	... 248,905	1·85d.	2·40d.	3·30d.	926	−928
1899	... 423,476	2·04d.	2·63d.	3·44d.	1,438	−1,465

In the face of these results we think that the general opinion must be that the charges are too favourable to the consumer. Only half of the financial charges are borne by the revenue, the other half appearing as a deficit. As these charges must increase, it appears that it is over sanguine to expect mere increase in output to set things right, and more particularly is this the case in face of a rising market for all the raw materials used in a generating works.

GENERAL STATEMENT.

	1898.	1899.	Increase.
Total capital expenditure ...	£47,047	£71,528	£24,481
Number of units sold	248,905	423,476	174,571
Number of lamps connected ...	13,644	20,741	7,097
Maximum load in KW.	245	378	133
Gross revenue	£3,417	£6,072	£2,655
Gross expenditure	£2,491	£4,634	£2,143
Gross profit	£926	£1,438	£512
Average price per unit sold ...	3·26d.	3·36d.	·10d.

The increase in capital expenditure is spread over all the items in this account, the greatest proportionate increase being in "site," and next in machinery. The rise in output is exceptionally good, and the connections are coming on fast.

The sales of energy show that the return per unit from this source is slightly higher than before. The average price obtained is 1·66d. from public lighting (151,195 units being taken by 24 arc and 265 incandescent lamps), and 3·95d. from private supply (272,281 units). The prices charged are 5d. and 2d. for lighting, and 5d. and 1d. for power and heating. Whereas in 1898 the wiring and fittings department traded at a loss, this last year there is shown a small profit.

REVENUE STATEMENT.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy	£3,375	3·26d.	£5,922	3·36d.	+·10d.
Meter rents	83	·08d.	117	·07d.	−·01d.
Profit on wiring, &c.	−76	−·07d.	10	·00d.	+·07d.
Rents received: premiums, &c.	35	·03d.	23	·01d.	−·02d.
Gross revenue ...	£3,417	3·30d.	£6,072	3·44d.	+·14d.

The costs have gone up slightly, due to the large increase in repairs. Coal shows a tendency to get up to ¾d. per unit, and the rise would have been half as large again were it not for the drop of nearly ¼d. in the wages item. The final result is an additional ¼d., but even at 2¾d. the total costs are very good for a works near London with less than half a million units output. Eliminating such items as street lighting charges, Mr. Harman Lewis gives the works cost at 1·805d. and the total cost at 2·397d.

COST OF PRODUCTION.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Coal and other fuel, and unloading same	£703	·68d.	£1,244	·71d.	+·03d.
Oil, waste, water and engine room stores	119	·11d.	324	·18d.	+·07d.
Salaries and wages incurred in generation and distribution and attending public lamps	905	·87d.	1,327	·75d.	−·12d.
Repairs and maintenance of buildings, engines, boilers, dynamos and street lamps	193	·19d.	695	·40d.	+·21d.
Works cost ...	£1,920	1·85d.	£3,590	2·04d.	+·19d.
Rent, rates and taxes ..	1	...	1	...	·00d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	350	·34d.	674	·38d.	+·04d.
General establishment charges, stationery and printing, law charges and insurance	220	·21d.	369	·21d.	·00d
Other expenses	...	...	...	...	...
Total costs ...	£2,491	2·40d.	£4,634	2·63d.	+·23d.

The only point about the profit statement not already referred to and worth mentioning is the curious relation still subsisting between the deficit and the gross profit. In both years these almost exactly equal one another. The total deficit to the end of the last financial year since the opening of the works now reaches £3,730—a rather heavy burden upon future profits.

PROFIT STATEMENT.

	1898.	1899.	
Interest on loans	£861	£1,397	=1·645d.
Sinking fund for repayments	993	1,506	
Net profit carried forward	− 928	−1,465	= ·830d.
Gross profit	£926	£1,438	= ·815d.

Cardiff Corporation Electricity Accounts.

THE accounts for last year of the electrical department of the Cardiff Corporation continue to show the disappointing result which we have had to deal with in previous analyses. It certainly seems that the reduction in price forced upon the department was not justified, when we consider the cost of generation and the pecuniary liabilities which had to be met. The output has been increased, but the augmentation in receipts has not been sufficient to cover the larger sums required to meet interest and sinking fund. Now we have not only heavier payments on these accounts, but also an increased figure for total cost per unit, coupled with a sensible reduction in the revenue per unit from all sources. The general statement shows one encouraging feature, that the business is being extended, and if this be continued on sound lines, no doubt the financial results will right themselves in time, but we cannot hope for an immediate improvement.

GENERAL STATEMENT.

	1898.	1899.	Increase.
Total capital expenditure ...	£71,028	£85,718	£14,690
Number of units sold	405,234	511,300	106,066
Number of lamps connected ...	18,427	27,250	8,823
Maximum load in KW.	420	495	75
Gross revenue	£7,056	£8,513	£1,457
Gross expenditure...	£5,112	£6,573	£1,461
Gross profit	£1,944	£1,940	−£4
Average price per unit sold ...	4·10d.	3·92d.	−·18d.

The revenue has increased by nearly £1,500, owing to the output being greater by over 25 per cent. than in 1898, while the load factor has considerably improved. Accompanying these changes is a fall in receipts from energy sold of nearly ¼d., bringing the average below 4d. per unit. The department is called upon to carry out the street lighting at a very low figure, *i.e.*, ·155d. per unit. This, we understand, is receiving attention, and the public lighting will be charged for at a higher rate this year.

REVENUE STATEMENT.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase
Sale of energy	£6,914	4·10d.	£8,348	3·92d.	−·18d.
Meter rents	140	·08d.	164	·08d.	·00d.
Sale of lamps, &c.	...	...	...	...	...
Other receipts	2	...	1	·00d.	...
Gross revenue ...	£7,056	4·18d.	£8,513	4·00d.	−·18d.

The costs show a steady fall in the amount per unit for engineering charges taken together, and an equally steady rise in the total cost. Coal and repairs are going upward, but the figures are fairly good, while economies are being effected in the oil, waste and wages items. The general tendency is best indicated in a summary :—

	Coal.	Oil, waste.	Wages.	Repairs.	Works cost.	Total cost
1897 ...	·59d.	·34d.	1·14d.	·34d.	2·41d.	2·99d.
1898 ...	·65d.	·29d.	1·01d.	·37d.	2·32d.	3·03d.
1899 ...	·81d.	·15d.	·81d.	·52d.	2·29d.	3·08d.

The items, more particularly under the engineer's control, are those in which most improvement is shown. Under repairs a sum of £150 was spent in renewing the rubber arc cables.

COST OF PRODUCTION.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit	Increase.
Coal	£1,100	·65d.	£1,721	·81d.	+·16d.
Oil, waste, water and engine room stores.	482	·29d.	322	·15d.	−·14d.
Salaries and wages incurred in generation and in distribution.	1,706	1·01d.	1,734	·81d.	−·20d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	621	·37d.	1,100	·52d.	+·15d.
Works costs	£3,909	2·32d.	£4,877	2·29d.	−·03d.
Rent, rates and taxes ..	217	·13d.	371	·17d.	+·04d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	701	·41d.	797	·37d.	−·04d.
General establishment charges, stationery and printing, law charges and insurance	247	·15d.	474	·22d.	+·07d.
Other expenses: certifying meters, stamp duty, &c.	38	·02d.	54	·03d.	+·01d.
Total costs ...	£5,112	3·03d.	£6,573	3·08d.	+·05d.

The sum required to meet financial charges in 1898 was £3,011. Last year this was increased by £723, and absorbed £3,734, equal to 1¾d. per unit sold, but as the gross profit was the same as previously, the whole of this increase appears as an addition to the net loss or deficit. Part of this sum of £1,794, which is equivalent to 84d. per unit, was provided by the rates, the remainder is carried forward to be dealt with at some future time. A sum of £1,106 appears in the general balance-sheet only. This represents the net proceeds of the action the Corporation took against Messrs. S. Z. de Ferranti, but what use would be made of this sum is not indicated in the accounts.

PROFIT STATEMENT.

	1898.	1899.
Interest on loans	£2,166	£2,715
Sinking fund for repayments	845	1,019
Net profit carried to general rate account	−650	−337
" " forward	−417	−1,457
Gross profit	£1,944	£1,940

CITY NOTES.

Adams-Randall Telephone Patents Company.

We have this week made application to the secretary for a copy of the report of the directors of this company, but our request has been refused on the ground that the report is private. As, however, the document has been reproduced more or less *in extenso*, with adverse criticisms, in several financial journals, we are reluctantly compelled to turn to these for the following facts. The company was formed in April last year to work the Adams-Randall telephone patents. It seems that £50,000 ordinary and £400 preference capital was allotted, and £8,150 in 6 per cent. first mortgage debentures issued. We suppose that the period under review has been purely experimental. Experimental expenditure is set down at £1,535, but far be it from us to suggest that there is nothing coming in to set against this and all the other expenditure, for there have been actual sales to the amount of £54 2s. 4d., which is a real proof that the company has been doing business. It is always a good sign when a business extends, and this sales item is larger than it was in the previous year, for then nothing at all was done; that, however, did not leave any doubt in the mind of the inventor or the company as to the practical value of the patents, for these were purchased for the good round sum of £54,743. To produce this £54 worth of goods and carry out preliminary and experimental work connected with the concern, much of which we should have thought ought to have been done before the patents were made the subject of a company, it has been necessary to pay salaries of engineer, &c., £1,026 directors' fees, £250; salary of secretary, £250; debenture interest, £641; advertisements, £357, and so on. It appears that all of the working capital that remained after paying for the patents amounted to £3,807, and this has been laid out upon the items we have mentioned and sundry purchases, office expenses, &c., with the exception of £37, which is at banker's and in hand. We need pass few comments upon this disastrous concern, which seems to have been brought out in a reckless manner, either when its patents were in an undeveloped condition or when it should have been clear that there was no immediate prospect of success. It appears that would-be customers have had to place their orders elsewhere because of the inability of the company to manufacture except in an experimental way. The invention was one which was to be applied cheaply to long-line telephone circuits, single-circuit telephony on long lines, submarine telephony, and what not, and its prospects have been dimmed either from want of working capital or from want of merit of the invention itself.

Kalgoorlie Electric Power and Lighting Company.

Mr. R. W. Wallace, Q.C., presided at the meeting of this company, held at Winchester House on Monday. In moving the adoption of the report, he went very fully into the causes of delay in proceeding with the operations, detailing the water supply difficulties, and the trouble that had arisen in obtaining a freehold site instead of one for only 21 years. If they could not obtain a satisfactory lease of the present site they must look elsewhere; the engines and dynamos, &c., which had been ordered would be suitable for either, but they were delaying the placing of the other contracts until the site matter was settled. They might receive a telegram any day saying that a longer lease had been granted by the Government, and if so they would then be able to push ahead. It was absolutely necessary that they should have a long tenure upon the site upon which they erected their plant. They at one time hoped that the water difficulty would have been met by the use of large gas engines, but those who had been at work in this direction had not yet produced one which would induce the board to use that source of power for the production of electricity. The vast expenditure of the work was in the boilers and evaporative condensing plant, and for that the order had not yet been given, as the board had only just made up their minds as to what they required. As in the case of certain London electricity supply companies, they must not expect the company to be remunerative in the first year or so of its existence, but there was every indication that in the future they would be earning large dividends and would increase the capital value. They had sent a competent engineer out to look up the mine managers so as to get them to adopt electricity and ensure their putting down the necessary motor plant so as to be ready for the supply as soon as available. The company would not do anything in mining work, their objects being the supply of light and power. Anything in the way of mining rights or lease would be disposed of to another company, which would repay them for their outlay upon that part of the concern.

The adoption of the report was seconded by Mr. H. W. Pelham Clinton, and carried after several questions had been put and answered. The directors' fees were thought high (£2,300), considering that there was nothing coming in, but it was explained that there was a board of seven in this country and a local board of four or five in Western Australia. The retiring directors and auditors were re-elected.

Nernst Electric Light, Limited.

The report of the directors from February 23rd, 1899, to September 30th last, to be presented to the meeting to be held in London on 19th inst., states that the expenditure on capital account during this period is shown to have been £9,696, while the disbursements on other accounts amount to £6,757. Acting on the advice of the auditors, the directors, after deducting from the latter amount £846, received on account of interest and transfer fees, have placed the balance of £5,911 to a development suspense account, to be dealt with in future years. Apart from the purchase consideration for the patent rights, the only prominent item of expenditure on capital account is £5,000 contributed towards the purchase for this company of Prof. Nernst's British royalties, the balance of the consideration having been provided by the vendors. As the owners of the British rights have not commenced business in England, this investment is still unproductive. Since the formation of the company the directors have been engaged in further developing the automatic Nernst lamp, so as to render it more capable of being manufactured and sold in quantities on a profitable commercial scale, and with a uniform degree of quality and efficiency for the various sizes; they have also taken out subsidiary patents, which, it is hoped, will prove of considerable value. The fire which occurred on the company's premises on May 31st, 1900, unfortunately destroyed the patterns, instruments, and apparatus collected during the previous 12 months, and notwithstanding the most strenuous efforts of the staff, progress was practically arrested for more than three months. While every discovery involving radical changes from existing methods must necessarily take time before the result can safely be placed on the market, the directors have found that the practical difficulties to be overcome in the wholesale reproduction of the Nernst lamp to the best advantage have been greater than they anticipated. The variations which occurred in endeavouring to repeat on a more extensive scale results already obtained, have involved lengthy experiments and chemical research in directions where no precedent was available. It is now, however, confidently hoped that the main causes of such variations have been traced to their origin, and means devised for their elimination. It should be considered that, although all the licensees possessing rights for other parts of the world commenced work many months before the formation of this company, and had, in most cases, the advantage of an organisation already equipped, this company has, in the opinion of the directors, made at least as rapid progress in the practical development of the lamp as other concessionnaires. According to the balance-sheet, the development suspense account amounts to £6,757, less interest, &c., £846.

Marconi's Wireless Telegraph Company.

The directors, in their report for the 13 months ended September 30th last, state that the period under review must be considered mainly as a further time of scientific and technical development. The International Marine Communication Company was registered during the spring of this year, and has allotted 100,000 fully paid shares to this company, and 5,000 fully paid shares to its nominees. The International Company has commenced work. Its first installations have been erected on the Belgian coast at La Panne, and on one of the Belgian Government steamers. These have been quite successful. The International Company has given orders for the erection of several stations on the coasts of the United Kingdom, and is engaged in negotiations with several Continental Governments. A contract has been concluded with the Admiralty for the supply and equipment of 32 sets of apparatus on payment of an annual royalty on each set. This is in addition to the five sets of apparatus which were transferred by the War Office to the naval authorities in South Africa.

R. Hornsby & Sons, Limited.

At the ordinary general meeting held on Monday at Cannon Street Hotel, Mr. H. Simpson Gee said that including the balance brought forward, the net profit amounted to £33,899, as compared with £50,069 in the previous year. This was a large reduction, but it was easily accounted for. Owing to the enhanced value of iron, steel and coal it had cost the company £20,000 more for raw materials during the period under review than in the previous year, without their securing any adequate increase in the price of machinery sold. Moreover, the turnover had not been quite so large, the sales having fallen off to the extent of £30,000. This was entirely due to the decline in their trade with the colonies. In the home trade their turnover showed no diminution. Having regard to the higher prices of coal and raw materials, the board thought that the result of the past year's operations was satisfactory. The present available profit was £30,889, out of which it was proposed to pay a half-year's dividend at the rate of 6 per cent. per annum on the preference shares, and 8s. per share, or 5 per cent., on the ordinary shares. These together would absorb £15,000. From the balance the board recommended that £10,000 should be placed to the reserve fund, leaving £5,899 to be carried forward.

Dublin and Lucan Electric Railway Company.

At an extraordinary general meeting of this company held in Dublin on Tuesday last week, the following resolution was unanimously carried:—

That an application be made to the Privy Council for powers to raise £3,750 in 5 per cent. cumulative preference shares of £10 each with corresponding borrowing powers for £1,250.

Prospectus.

This week the Diesel Engine Company has been offering for subscription 40,000 5 per cent. £1 preference shares. The nominal capital is £500,000, and the vendor takes 325,000 £1 ordinary shares and £25,000 in cash as purchase money for the patents for the United Kingdom and certain Colonial and foreign countries. The remaining shares are reserved for future issue. Mr. Rudolf Diesel is the inventor of the engine, and he is one of the directors of the company. The offices are 171, Queen Victoria Street, E.C. The list closed yesterday. It was the intention of the board to go to allotment on a minimum subscription of £30,000.

Edmundson's Electricity Corporation.—Letters of allotment for the issue of 13,363 preference shares of £5 have been posted. The issue has been over-subscribed.

County of London and Brush Provincial Electric Lighting Company.—The transfer books and register of holders of debenture stock will be closed from 17th to 31st inst., inclusive.

City of London Electric Lighting Company.—The transfer books and register of holders of the £400,000 5 per cent. first debenture stock will be closed from 17th to 31st inst.

Eastern Telegraph Company.—The directors announce an interim dividend of 1½ per cent. on the ordinary stock for the quarter ended September 30th.

Stock Exchange Notices.—Application has been made to the Committee to appoint a special settling day in and to grant a quotation to—London United Tramways, Limited—4 per cent. first mortgage debenture stock.

Commercial Cable Company.—The directors announce a quarterly dividend of 1¾ per cent. and a bonus of 1 per cent. on the capital stock, payable 2nd prox.

Meetings.—Reports of meetings of the Aron Electricity Meter Company and the India-Rubber, Gutta-Percha, and Telegraph Works Co., held yesterday in the City, are held over until next week.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending December 8th were £139; corresponding period last year, £127; increase, £12. Total to date, £19,852; corresponding period last year, £19,864; decrease, £15.

Bristol Tramways and Carriage Company.—The receipts for the week ending December 7th were £3,065 17s. 4d.; corresponding period last year, £2,630 19s. 7d.; increase, £434 17s. 9d.

Central London Railway.—The receipts for the week ending December 8th were £5,766; previous week, £5,740; decrease, £26. Total receipts to date (19 weeks), £99,427. Miles open, 6.

City and South London Railway.—The receipts for the week ending December 9th were £1,915; corresponding week last year, £1,110; increase, £805. Total to date, £37,775; corresponding period last year, £22,671; increase, £15,104. Miles open, 1900, 4¼; 1899, 3¾.

Cork Electric Tramways and Lighting Company.—The receipts for the week ending December 6th were £348 8s. 10d.; corresponding week last year, £358 16s. 10d.; decrease, £10 8s. 0d. Total to date, £19,995 9s. 7d.; corresponding period last year, £18,575 13s. 9d.; increase, £1,419 15s. 10d.

Dover Corporation Tramways.—The receipts for the week ending December 8th were £167 1s. 2½d.; corresponding week last year, £145 6s. 5d.; increase, £21 14s. 9½d. Total to date, £10,087 9s. 8d.; corresponding period last year, £9,608 0s. 7d.; increase, £479 9s. 1d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,926; 1899, 4,714. Number of cars, 1900, 11; 1899, 11.

Dublin United Tramways Company.—The receipts for the week ending December 7th were as follows:—D. U. T. Co., electric cars, £3,328 3s. 4d.; ditto, horse cars, £232 2s. 8d.; D. S. D. Co., electric cars, £691 0s. 6d.; total, £4,042 6s. 6d; corresponding week last year—D. U. T. Co., electric cars, £2,807 2s. 10d.; ditto, horse cars, £137 2s. 3d.; D. S. D. Co., electric cars, £672 9s. 8d.; total, £3,616 14s. 9d.; increase, £425 11s. 9d.; aggregate to date, £107,057 4s. 1d.; aggregate to date last year, £95,968 5s. 0d.; increase, £11,088 19s. 1d. The mileage worked is 44 miles electrically, 1 mile by horses, as against 37 miles electrically, 7 miles by horses, for the corresponding period last year.

Liverpool Overhead Railway.—The receipts for the week ending December 9th were £1,488; corresponding week last year, £1,453; increase, £35. Total from July 1st, 1900, £38,131; ditto corresponding period last year, £37,476; increase, £655. Miles open, 6·57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The electrical markets have had little to excite them this week. While the money market continues hard, there is an abundance of floating cash, and this somewhat anomalous situation rather deters investors from embarking in Stock Exchange purchases. It is felt that with the chance of an end-of-the-year squeeze in Lombard Street, investment stocks may yield in price to some extent, and the very uncertainty keeps the public away. It appears to us that a rise in the bank rate before 1901 is very unlikely to take place, there being plenty of money for all the purposes for which it may be required.

Against a rise of 10s. in County of London Preference shares, has to be set a fall of similar proportions in London Electric Preference. The latter are, of course, a very speculative investment, and it will be remembered that the company had to pass the dividend on the shares last September. County Preference are good, by reason of the continued absorption of the higher grade securities in the supply department, a movement which is still further underlined this week by advances in Edmundson's 4½ per cent. and Metropolitan 3½ per cent. Debenture stocks. It is a usual occurrence nowadays for the dealers in the market to have three or four brokers one after the other inquiring what Debenture stocks are on offer. The best stocks are hard to find at all, being apparently in good hands. For Westminster Ordinary shares there has been a fair amount of inquiry, but the price is nominally unaltered. New Westminsters are £12 middle; new Charing Cross 5⅝, and new Chelseas ¼ premium, Edmundson's latest issue also commanding 5s. premium.

No fresh emissions of any market consequence have been made during the week, but the prospectus of the Federal Electric Company, from across the Atlantic, has served to amuse a good many on this side. Some $2,500 are wanted to ascertain whether a new generator has any practical utility, the inventor claiming that the battery may turn the whole electrical business of the world inside out. The prospectus stoutly says, "It costs next to nothing to take the chance. If you lose, you won't lose anything in particular. If you win you can simply quit working and sit back and enjoy yourself."

West India and Panama Telegraph Ordinary shares can hardly go much lower in price, the £10 fully-paid Ordinary standing at 15s., so there is no particular cause why the proprietors of this class should be alarmed at the agitation now on foot in British Guiana for the establishment of a new cable between the West Indies and the mother-country. The company's agreement with British Guiana comes to an end on December 31st, 1901, and some of the Colonies are talking of combining in order to obtain a British line that shall be cheaper and more expeditious than the West India and Panama. None of the company's securities have moved ⅛ on the threat, and in the Stock Exchange it is thought that were any fresh arrangement arrived at, the British Government would take over the company altogether.

Cuba Telegraph Ordinary, following the example of the Preference last week, have put 10s. on to their price, but the American group is decidedly dull, with the exception of the Commercial Cable Company's stock, for which buying orders have come from Wall Street, with the result that a gain of $5 has to be noted. Apart from this, Anglo-American, Direct United States, and Submarine Cables stocks all show a decline. The first-named seem to have no stamina, nor does the continuance of activity in the American railroad market help the quotations in any degree. On the other hand, the Eastern group is steadier, and for the first time for a month there is no drop in Eastern Ordinary to chronicle. The "China" securities are also hard.

Furious controversy rages round the position of the Central London Railway as to the liability of the company for damages in respect of the vibration felt by occupiers of premises along the route of the "Tube." Again, the Ordinary and Deferred shares fell this week, but recovered again, while the Preferred halves are better on the assumption that their 4 per cent. dividend is fairly secure. The making-up price on Tuesday was 9¼, comparing with 10¼ at the last settlement, and those who carried over shares on the "bull" tack were charged as much as 6 per cent. City and South London stock displays no improvement, but Waterloo and City keeps steadily on the up line.

Encouraged thereto by the final preparations for laying the Pacific cable, buyers have come along with intelligent inquiries for Construction shares. British Insulated Wire are particularly wanted, and the price has jumped up a sovereign, to 11½. Quiet dealings in Telegraph Construction and Telegraph Manufacturing shares have evidenced the predominance of the purchasing element, but the market being well supplied with stock, the quotations are still the same. Callender's and Henley's, both standing at 13, are good second-class investments, and return 5½ per cent. at current prices. The companies are well established, and have not to work up a connection, unlike the Marconi's Wireless Telegraph enterprise, whose report is out this week. We are glad to see that the directors do not fan the extravagant hopes held out by certain interested parties, but their statement anticipates, naturally and, perhaps, fairly enough, increased business in the immediate future. The price of the shares is 3⅞ to 4, and we do not see any intrinsic reason why they should be worth more for some time to come.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotations December 5th.	Closing Quotation Dec. 12th.	Business done during week ended Dec. 12th, 1900. Highest.	Lowest.
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
119,700	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	85 — 90	85 — 90	...	...
822,700	Anglo-American Telegraph	Stock	3 %	£3 9s.	73/6	53 — 56	52 — 55	53	...
3,088,540	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	97 — 99	97 — 99	99	97½
3,088,540	Do. do. Deferred	Stock	...	18s. %	£1 7s.	10¼— 10⅜	9⅞— 10¼	10¼	10
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	4 %	3 — 3½	3 — 3⅛	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	165 —175	170 —180	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	103 —104	103⅞	103
16,000	Cuba Telegraph	10	7 %	8 %	7 %	6 — 7	6½— 7⅛	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	15 — 16	15 — 16	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104%	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3 %	10¼— 10¾	10 — 10⅛	...	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	138 —143	138 —143	141	138
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	96 — 99	96 — 99	97¼	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	110 —114	110 —114	111	110
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13⅜— 14½	13⅜— 14½	14 5/16	13⅜
50,000	Do. Nos. 250,001 to 300,000 (iss. at £3 pm. all pd.) £6 pd.	10	...	...	...	9½— 9¾	9½— 9¾	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	113 —118	113 —118	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	...	..
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	99—102%	99 —102%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5½%	5½%	10½— 10⅝	10½— 10⅝	10⅝	10½
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15 — 15½	15 — 15½	15⅛	...
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	12½%	...	31 — 33	31 — 33	...	...
84,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	48	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	104 —107	104 —107	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	2½%	¼— ⅛	¼— ⅛	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	4 %	5 %	⅜— 1	⅜— 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	6 %	5 %	4⅜— 4⅝	4⅜— 4⅝	4⅝	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	..
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5 — 5¼	5 — 5¼	...	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 —99	96 — 99	98	...
500,000	Do. 4 % Deb. Stock Red.	100	...	...	...	101 —104	101 —104	101⅛	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	101 —104	101 —104	...	...
11,839	Reuter's...	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	124 —129	125 —130	126½	125
58,000	United River Plate Telephone	5	5 %	6 %	7 %	4½— 5	4½— 5	...	...
16,639	Do. do. 5 % Cum. pref. Nos. 1—16,639	5	...	...	...	5 — 5½	5 — 5½	...	...
23,361	Do. do. Nos. 16,640 to 40,000 £3½ pd.	5	...	...	...	3½— 3¾	3½— 3¾	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	99 —102	99 —102	100½	99½
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	14 — 14½	14 — 14½	14⅝	14
75,000	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	103 —106	103 —106	...	...
348,777	Do. do. 4 % Deb. Stock Red.	100	...	...	...	102 —105	102 —105	...	...
88,321	West India and Panama Telegraph	10	2½	2 %	⅛%	⅜— 7/16xd	⅜— 7/16	5/8	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	6 — 7 xd	6 — 7	6 7/16	6
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	5 — 7 xd	5 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	105 —108	105 —108	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	7⅝	7 5/16
12,000	Do. do. 7 % Cum. Pref....	5	7 %	...	...	8½— 9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9½— 10½	9½— 10½	10	9 11/16
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 6	5½— 6	5 15/16	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	6 %	6½— 7	6½— 7	6⅞	6 5/16
150,000	Do. do. do. % Deb. Stock Red. ...	Stock	4½%	...	...	110 —113	110 —113	111⅝	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	10 %	6 %	4 %	9 — 10	9 — 10	9⅜	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	13 — 14	13 — 14	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	4 %	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11 — 12	11½— 12½	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	108 —111	108 —111	109	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5	4½— 5	5	4 1/16
75,000	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	101 —104	102 —105	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1⅞— 2¼	1⅞— 2¼	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	6 %	...	4½— 5½	4 — 5	...	...
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	100 —102	100 —102	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	12½— 13½	12½— 13½	12 11/16	12⅝
220,000£	Do. 4½% First Mortgage Debenture Stock	...	4½%	...	...	112 —115	112 —115	114	...
250,000	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	97 —100	98 —101	99⅜	99½
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	14½— 15½	14½— 15½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	...	..
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9	8 — 9	...	...
150,000	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	100 —103	100 —103	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000	Do. do. 4 % Deb.	100	...	...	...	85 — 95	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2½— 3½	3⅛	3
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	12 %	13 %	12 — 13	12 — 13	12⅝	12 7/16

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

Quotations on Liverpool Stock Exchange.
‡ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation Dec. 5th.	Closing Quotation Dec. 12th.	Business done week ended Dec. 12th, 1900. Highest	Lowest
20,000	British Aluminium 7 % Cum. Pref.	‡ £10	...	...	...	9 — 10	9 — 10	9⅜	...
300,000	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	91 — 95	91 — 95	...	...
45,000	British Electric Traction	£10	...	6 %	...	14 — 15	14 — 15	14½	...
50,000	Do. do. 6 % Cum. Pref.	£10	...	...	...	12 — 13	12 — 13	12⅝	12 5/16
350,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	120 —123	120 —123	121¾	121½
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	⅛ — ¾	⅛ — ¾	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000 ...	...	...	...	...	⅝ — ¾	⅝ — ¾	...	...
500	† Do. do. 4½ % 1st Mort. Deb. ...	100	...	...	...	97 — 99	97 — 99	...	...
70,000	British Insulated Wire Ord.	5	15 %	15 %	20 %	10 — 11	11 — 12	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅜— 6¼	5⅜— 6¼	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	3 %	5 %	6 %	1⅝— 1⅞	1⅝— 1⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	2 3/16	2
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	106 —111	106 —111	107	...
108,710	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	103 —105	103 —105	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	12½%	15 %	15 %	12½— 13½	12½— 13½	12⅞	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5¼— 5⅝	5¼— 5⅝	5⅝	5½
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	S ock	...	...	...	110 —114	110 —114	...	...
206,297	Central London Railway, Ord. Shares	10	...	...	...	9¼— 9⅜	9½— 9⅝	9½	9 13/16
78,703	Do. do. Pref. half-shares	5	...	...	...	4 — 4½	4⅝— 5⅛	5	4 15/16
78,703	Do. do. Def. do.	5	...	...	...	4½— 5	4 — 4½	4 5/16	4½
855,000	City and South London Railway	Stock	1⅞%	2⅛%	1⅞%	52 — 56	52 — 56	53	52½
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000 ...	10	...	...	...	4½— 5½	4½— 5½	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	...	6 %	7½%	3½— 4	3½— 4	4	...
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	6 %	1⅝— 2¼	1⅝— 2¼	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	6 %	3½— 4½	3½— 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	90 — 92	90 — 92	...	...
100,000	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	96 —100	96 —100	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	2	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	7 %	...	2⅜— 3¼	2⅜— 3¼	...	...
182,500	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	10	7 %	7 %	7 %	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	12½— 13½	12½— 13½	13	12½
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5¼— 5⅝	5¼— 5⅝	5¼	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	...	...	108 —112	108 —112	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅝	21 9/16
300,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100—103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3½%	3⅜%	8⅜— 8⅞	8⅝— 8⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5	13¼— 13½	13¼— 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	38 — 42	41	39½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	... %	101 —104	101 —104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	8 %	12 %	10 — 11 xd	10 — 11	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5¼— 5⅝	5¼— 5⅝	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	93 — 96	94 — 97	96¼	95½

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Brompton and Kensington, 4½ % Debentures of £100, 104—107.
National Electric Free Wiring, 12/6 paid, ⅛—⅜.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16—17.
Do. do. Pref. (£10 pd.), 10—11.
* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 11½—12½; 1st Preference Cumulative 6 % £5 (fully paid), 6½—7. Debentures, 102—105. Dividend, 1899, on Ordinary Shares 11 %.
*T. Parker, £10 (fully paid), 16⅜.

Bank rate of discount 4 per cent. (July 19th, 1900).

MARKET QUOTATIONS, Wednesday, December 12th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ,, ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17 10	£17 10	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25	£25	..
a Lead, Nitrate	per ton	£25	£25	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	3½d.	3½d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	64/-	64/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks ..	per lb.	2¾d.	2¾d.	..
METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£80 to £140	£80 to £145	dec.
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8½d.	8½d.	..
c ,, Wire, basis	per lb.	8½d.	8½d.	..
c Copper Tubes (brazed) ..	per lb.	11½d.	11½d.	..
c ,, ,, (solid drawn) ..	per lb.	11d.	11d.	..
g Copper Bars (best selected) ..	per ton	£86	£86	..

METALS, &c, *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£86	£86	..
g ,, Rod	per ton	£86	£86	..
c ,, (Electrolytic) Bars ..	per ton	£83 10	£83 10	..
c ,, ,, Sheets ..	per ton	£93	£93	..
c ,, ,, Rod ..	per ton	£85 10	£85 10	..
c ,, ,, H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha fine	per lb.	8/6	8/6	..
h India-rubber, Para fine	per lb.	3/9½ to 3/10½	3/8½ to 3/9½	inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	60/7½	60/7½	..
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£11 10	£11 10	..
g Lead, English Ingot	per ton	£16 5 to £16 7 6	£17 to £17 2 6	15s. dec.
g ,, ,, Sheet	per ton	£19	£19	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 2 6	£9 2 6	..
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/1 to 1/4	dec.
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/8	From 1/8	..
o Platinum	per oz.	£3 18	£3 18	..
p Silicium Bronze Wire	per lb.	10½d. to 1/-	10½d. to 1/1	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£122 to £123 10	£123 to £123	£6 dec.
g ,, foil	per lb.	2/-	2/-	..
n ,, wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	9½d.	9½d.	..
j ,, Best Flax, 6 lea.	per lb.	5½d.	5½d.	..
j ,, Hemp, 3 ply 10 lbs.	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5½d.	5½d.	¼d. inc.
j ,, Jute, 180 lbs. rove ..	per ton	£14 10	£14 10	..
k Zinc, Sh't. (Vielle Montagne bnd.)	per ton	£28 2 6	£28 2 6	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakespeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Henry[C. Yee & Co.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited. *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company, Ltd

Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

CABLE JUNCTIONS IN THE ROYAL NAVY.

The two junctions that are most used in electrical circuits in the Royal Navy are respectively known as "Britannia" and "German" junctions. These junctions are made either permanent or temporary as the case requires.

A "German" junction is used for joining small pliable wires of a similar nature, and is made as follows:—

The insulation having been removed for about 3 inches from the ends of the cores, a piece of india-rubber tubing is slipped over one of the ends; the core, which consists of several wires, is then divided, and the two parts joined together with what is known as a "ropeyarn knot."

A ropeyarn knot is made by "marrying" the two parts formed for the purpose, and then tying one part of each core together in the form of a reef knot, but in such a manner as to enclose the other two untied parts within the heart of the knot itself. The ends are then cut off and the india-rubber tubing slipped over the knot, its two ends being firmly bound with a piece of whipping to the insulation at each end. This forms a very neat and reliable junction which is quite watertight. If it is only required to make the junction temporary, the knot is dispensed with, and ordinary twisting of the wires together resorted to, but there can be no securer contact than the ropeyarn knot, and none more thorough for practical purposes. Another method of insulating this junction is by means of rubber tape and solution, but this is not nearly so neat.

A "Britannia" junction is made when a single thick wire has to be joined to a similar one or to a strand of fine wires. In making it the ends are bared as before, and a piece of tubing placed over one of them; the two cores are then placed side by side with about a quarter of an inch of the end of each bent at right angles with the pliers. The two cores are then bound together with thin binding wire and the ends turned down over the whole so as to secure the binding; the tubing is then slipped over the junction and secured as before.

Permanent junctions are generally made with solder; they are very often insulated first with rubber tape and solution and then with the rubber tubing.

Where a "forked" junction is required, as in gun circuits where a branch is required from the main wire, the core of the branch is carefully bound round the core of the main to a distance of from 1 to 2 inches, and insulated by means of rubber tape and solution.

The junctions in lead-covered cables are made in a somewhat different manner; after the insulation and lead covering have been removed for some distance, the lead covering being removed to a distance of an inch beyond the insulation, the two outer layers of the conductor are laid back, and the remaining cores being cut somewhat shorter are butted together and the outer layers then laid over them again. A copper wire seizing is then put over the centre of the junction and another on either side of it, and solder run through the whole; a sleeve of lead sheeting is finally soldered over the place after the core has been bound round with dry cotton tape up to the diameter of the seizing, and made to project at least half an inch on either side of the lead casing. It is usual to coat the tape insulation with black japan varnish.

What is known as a T junction is made in these cables for forking a sub-main into a main cable, by laying back the two outer layers of the branch and then halving the core, the two parts of which are cut to such a length as to just meet round the main core; here they are nipped and the outer layers laid up on either side to right and left, the insulation and covering being placed on them in much the same way as before.

For armoured cables connecting boxes are generally used, which nip the cables and prevent the strain coming on the core, which is joined with an ordinary German junction.

In cases of emergency an expedient is sometimes resorted to where a connecting box is not handy, and there is no time to splice the cable—a kink is made at the junction and the two parts securely seized together where they cross; this takes any direct strain off the junction itself.

INSTITUTION OF ELECTRICAL ENGINEERS.

ON THE SUPERSESSION OF THE STEAM BY THE ELECTRIC LOCOMOTIVE.

By W. Langdon, Vice-President.

(Paper read November 29th, 1900.)

(*Concluded from page* 926.)

A generating plant capable of an output of 10,000 kw. is, of course, ample to provide for a calculated demand of just half that amount. I adopt the following estimate as applicable to the prime cost:—

Generating Station.		
Buildings, foundations, chimney stacks, &c. ...	£50,000	
Equipment, including steam units, boilers, coal conveyers, steam mains, condensers, pumps, &c.	200,000	
		£250,000
Sub-stations.		
Buildings—five stations	10,000	
Equipment of ditto with transformers, converters, &c., delivering at 600 volts, and all necessary fittings	70,000	
		80,000
Cables, including laying	70,000	
Contract rail—200 miles (*i.e.*, four roads of 50 miles each)	70,000	
		140,000
Total capital outlay for generation and distribution of current		£470,000

The figures comprised within the two first items are practically those given by Mr. Parshall with reference to a somewhat similar plant, with the exception that the amounts have been increased to the extent of £15,000 for the generating station equipment, consequent upon the adoption of a higher voltage; and £10,000 for generating station buildings to meet any advance of prices. £10,000 has also been added for independent transformer buildings. The cost of cables, including laying in position, is based upon the current demand and mileage.

The hourly demand has been shown to be 5,000 kw. The annual output for the section of line under consideration will therefore be this amount multiplied by the 24 hours per day, and 365 days to the year, viz., 43,800,000 kw.-hours.

On this basis I estimate the annual cost for generation and distribution of current as shown in the annual column of the following table, from which, by dividing the sums there shown by the annual kw. output, I obtain the per kw.-hour charge.

To the foregoing we have to add the cost for drivers and assistants in attendance upon the electric locomotives—performing practically the same duties as the driver and firemen in attendance upon the steam locomotive; together with that for repair and renewal of all machinery, including the locomotives.

In his presidential address to the members of the Institute of Mechanical Engineers in 1898, Mr. S. W. Johnson, the locomotive engineer for the Midland Railway, furnished valuable data in relation to the cost of moving railway trains. From this data I, by his courtesy, am enabled to furnish the details shown on Table VI.

Table V.—Estimated Cost of Generation and Distribution of Current.

Details of charges.		Per annum. £	Per kw.-hour. Pence.
1. Capital outlay, £470,000. Interest at 3½ per cent.		16,450	0·0901
2. *Generating Station.* Salaries and wages:—	£		
1 Chief engineer	500		
1 Assistant ditto	250		
3 Switchroom attendants, at £150 each	450		
1 Clerk	120		
7 Engine room attendants, at 40s. each per week ...	728		
7 Assistant ditto, at 35s. each per week	637		
12 Stokers, at 30s. each per week	936		
15 Labourers and cleaners, at 22s. each per week ...	858		
		4,479	0·0245
Coal. At 3·0 lbs. of coal per kw.-hour—58·667 tons, at 7s. 11½d. per ton		23,345	0·1279
Water. At 25 lbs. per kw.-hour, and 2d. per 1,000 gallons		913	0·0050
		28,737	0·1574
3. *Sub-stations* (5). Salaries and wages	£		
5 Assistant engineers at £200 each...	1,000		
20 Attendants, at 40s. each per week	2,080		
20 Assistant attendants at 35s. each per week	1,820		
10 Cleaners at 22s. each per week	572		
		5,472	0·0299
4. *Out-door Service.* 5 Rail jointers and fitters, at 40s. each per week ...	£ 520		
Material, &c.	230		
		750	0·0041
5. Oil, waste, and sundries		2,000	0·0109
Total estimated cost of generation and distribution of current		£36,959	0·2023

TABLE VI.—STEAM LOCOMOTIVE CHARGES.

Average Midland Railway total locomotive expenditure, &c., during 24 years, 1873—96.	£	Cost per train mile. Pence.
Running Expenditure.		
Wages:—Drivers and firemen	358,635	2·650
Cleaners, coal men, &c. ...	94,422	0·698
Water	28,575	0·211
Oil and stores	44,842	0·331
Coal and coke	289,595	2·139
Total running expenditure	£816,069	6·029
Repairs and Renewals.		
Wages	178,718	1·320
Materials	178,742	1·321
Total repairs and renewals	£357,460	2·641
Salaries	24,187	0·179
Turntables and buildings	2,861	0·021
Gas	9,868	0·073
Gross expenditure	£1,222,899	8·943

Tons of coal and coke consumed ...	727,889
Cost per ton	7s. 11½d.
Train mileage	32,485,530

This table shows that the average cost for 24 years, for drivers and firemen was £358,635, or 2·650 pence per train mile; and that for repairs and renewals, £357,460, or 2·641 pence per train mile.

To arrive at the cost for drivers and attendants for the electrical locomotive, I might revert to Table IV. and deduce from it, at a given rate of wage per hour, for the number of trains occupying the line for that period, the kilowatt-hour cost, but this, it appears to me, would not be quite right. There can be no question that the cost incurred by the locomotive department is extremely heavy,* but it is a charge incumbent upon the working of the traffic, and whatever are the conditions which militate against a reduction in this charge with the locomotive department, presumably they would hold good against the electric unless the traffic could, under the latter, be so facilitated as to enable it to be got through with greater speed, and less shunting. It is not clear this could be done. I am therefore, very reluctantly I must admit, obliged to adopt the extremely heavy cost incurred by the steam locomotive, for there would be very little, if any, difference in the rate of pay to the respective class of men.

The repair and renewal of electrical machinery, whether in relation to the generating or the locomotive plant, should be considerably less than that of the steam locomotive plant, for the reason that there will be extremely few moving parts, while many small units, used for pumping and other like purposes, would be provided for from the central generating station at a less cost, or entirely abolished.

The train mileage (Table IV.), run by the 14 trains during one hour, is 479. Assuming that the cost attending the repair and renewal of the electrical machinery will be 2d. per train mile, as against that for the steam locomotive power and works, viz., 2·641, we shall have a result of 0·1916 pence per kilowatt-hour.

There is yet one more addition to make. The cables and contact-rail are peculiar to the electrical system. I do not include them in the above 2d. per train mile for repair and renewal of machinery. Having regard to the value of the recovered material, I assume 2½ per cent. on the primary outlay will meet the renewal of cables, and 4 per cent. that of the contact-rail. This means 0·0249 pence per kilowatt-hour.

Table VII. furnishes all these items, against each of which is also shown the cost per train mile, *i.e.*, the cost per kilowatt-hour multiplied by the total output, viz., 5,000 KW. for the hour's work, divided by the train mileage worked during the hour, viz., 479.

TABLE VII.—ELECTRICAL CHARGES.

Cost in pence, per kilowatt-hour, and per train mile.

	Per kilowatt-hour.	Per train mile.
Generating charges	0·1574	1·643
Sub-stations charges	0·0299	0·312
Out-door attendance	0·0041	0·043
Oil, waste, and sundries	0·0109	0·114
Locomotive drivers and assistants. (This item is shown at the cost incurred under present mode of working.)	0·2538	2·650
Repairs and renewal of machinery, motors, &c.	0·1916	2·000
Renewal of cables and contact-rail ...	0·0249	0·259
Total cost for power and haulage	0·6726	7·021
Interest at 3½ per cent. on primary outlay, viz., £470,000.	0·6901	0·941

Therefore, if my deductions are correct, it would appear that the cost of working by electricity as against that for the steam locomotive is, per train-mile, so far as the Midland is concerned, as 7·021 to 8·943 pence, being an apparent saving of 1·922 pence per train-mile, or £260,155 on the average yearly cost for the 24 years indicated.

A closer comparison of the chief items may help us to learn where and how so large a saving is effected.

Coal stands in Mr. Johnson's data at 727,889 tons, at a cost of £289,595. Based upon the figure adopted by me, viz., 3·0 lbs. per kilowatt hour, the tonnage required is 454,145,* and the money £180,712.† The steam locomotive consumes on the average 50·191 lbs. of coal per train mile. My figures place the quantity required for electrical energy at

$\frac{(5{,}000 \times 3{\cdot}0)}{479}$ 31·315 lbs. The saving under this head is, therefore, 273,744 tons, which at 7s. 11½d., will account for £108,927. We have to bear in mind that the calculation on which the cost of electricity is based makes no provision for shunting operations. It is based entirely upon the train mileage run. Shunting work is, of course, included in Mr. Johnson's figures, and will account, to some extent, for the difference. The main gain, however, is to be found in the economy of a stationary, as against an itinerant generator, as well as in the fact that much coal is consumed by goods and mineral trains when shunted, and by all trains when standing at stations, the whole of which would be saved if worked by electricity.

With stationary engines a less expensive coal than that used for locomotives would be available, thereby effecting a reduction probably more than sufficient to meet the cost for shunting previously alluded to. It may be pointed out that coal is more costly at present. Such is the case, and, were my calculations based upon the present rate of coal, the result would largely enhance the advantage of electricity. Say, for instance, that coal stood at 10s. instead of 7s. 11½d., the locomotive cost would be 727,889 tons at 10s. = £363,944 instead of £289,595. That for electricity would be 454,145 tons at 10s. = £227,072, instead of £180,701. The result would be that electricity would show, under coal at 10s. a ton, a saving of £136,872 instead of £108,927, on precisely the same mileage, with a proportionate increased saving at prices ranging above that figure.

The fact that dear coal enhances the comparative value of an electrical system—especially with the possibility of coal at a higher rate than 7s. 11½d.—cannot be too strongly emphasised.

Water.—The steam locomotive calls for £28,573, or 0·211d. per train mile; electricity, £7,066, or ·0522 per train mile—a difference in favour of the latter of £11,507. It is difficult to attempt a comparison between the cost of a largely-scattered supply — water pillars at numerous stations—and a concentrated one—one to every 50 miles or so of line. The site for such a generating station would naturally be selected with a view to cheap water supply, and, as a rule, no great difficulty would attend its selection. A further point to be borne in mind is that, naturally, all machinery would be of the most modern and economical type, and that the working would reach the highest ideal for an electrical plant, viz., an actually constant and perpetual demand.

Drivers.—It is quite clear that whatever may be the cause of the existing heavy charges, it will apply equally to electric as to steam locomotives. The engine must stand by its train, and the men along with it. Any reduction that may be effected will be in the mode of dealing with the traffic. The present condition, viz., that of a mixed traffic travelling at various rates of speed—one class of train being required to make room for another of a more important character—is not destined to effect economy in this branch of expense.

Repair and Renewal.—I have assumed that the cost of repair and renewal would be practically ⅛th less with electricity than steam. I think I am more than justified in this. The wear and tear of stationary engines, or motors, cannot possibly be so great as that of the steam locomotive. The number of electric locomotives would necessarily be as great, but their wearing parts would be immensely less than those of the latter. Many local units would be entirely dispensed with.

Oil and Stores forms a somewhat large item in the running expenses of the steam locomotive. Much of this is for the lubrication of moving parts which would be non-existent in electric engines. Moreover, with stationary engines it is possible to recover, and again use, a great portion of the lubricator employed. It would appear that considerable economies in oil should accompany the employment of electricity.

We may now perhaps glance at possible economies on that which is indispensable for the steam locomotive, but which is unnecessary, or not so largely necessary, with electricity. Water pillars, turntables, engine sheds, coal stages—all these are expensive items which with electricity are either not required, or capable of considerable modification.

Water pillars, supplemented in many instances by fixed engine power for pumping the water into reserve tanks, involving power houses, sheds, and other structures, form part of all large stations and many other points at which the locomotive requires to take water. With electricity, water to any extent would be required only at that point at which the central generating station is placed. If this station served 50 miles of railway, then it would take the place of all the pumping plants, water pillars, &c., otherwise required throughout that section for the steam locomotive. Every

* Assuming the weekly wage of driver and fireman to amount to 90s., probably an excessive sum, it would seem that the weekly mileage travelled would be but 407. If the wage were 70s., the mileage would be but 317.

* $\frac{5{,}000 \text{ KW.} \times 3{\cdot}0}{479} = 31{\cdot}315 \quad \frac{32{,}485{,}530 \times 31{\cdot}315}{2{,}240} = 454{,}145 \text{ tons.}$

† $\frac{1279\text{d.} \times 5{,}000 \text{ KW.}}{479} = 1{\cdot}335073\text{d. per T.M. } 32{,}485{,}530 \text{ T.M.}$

$\times\ 1{\cdot}335\text{d.} = £180{,}711.$

pumping station involves the provision of labour, fuel, &c. All water pillars require special attention during hard weather. Economies in first outlay and annual charges on this account should accompany the use of electricity.

Turntables would be unnecessary. The annual outlay for repairs in this respect is not great, but the cost of laying down the large turntables now required is very heavy.

As the number of locomotives increase, so increases the demand for engine sheds. Electric locomotives would of course need housing as well as the steam locomotive, but the space which they would occupy would probably be about half that now required.

Wherever we find an engine shed, there we see an area of land covered with coal; lines of rails applicable thereto; coal stages to which the coal has to be carried, and from which it has to be distributed to the locomotives. First the coal has to be stacked, then loaded into trucks and carried to the coal stage; and thence weighed and placed on the engine's tender. This is the course of procedure at each engine depôt. If we compare it with the work of a large central station, such as that sketched out in this paper, I think it will come home to us that although the work would be large, it could not be nearly so large as at present. If stacking were at all necessary there would be the less quantity to stack, and it would all be dealt with in a more concrete form and at comparatively few centres. Again, in this respect there is reason to look for economies in land, in buildings, and labour.

All these are assets directly due to the employment of electricity. Others, not considered in the figures which I have advanced, would, with its presence, be available: the lighting of the trains, stations, goods warehouses and yards, marshalling grounds, &c.; signalling, to some extent, might become automatic; while at large centres where signal boxes have become both numerous and cumbrous, it would appear but reasonable that, with the aid of such a power, points and signals might not only be actuated, but the means for operating them might be so condensed as to admit of the entire duties being embraced within such a space as would enable one man to deal with them. Labour and space would be economised, and less time would be occupied in giving effect to the various operations than is possible with the existing means. To this we may add that obviously it would also provide for the operation of lifts, and other local demands for power which at present have to be met by isolated plants.

Let us now turn to what may perhaps be regarded as difficulties to be encountered.

The first question that will arise will be:—Are we safe in placing so many of our eggs in one basket? With the steam locomotive we have a travelling unit which has to manipulate its own load and is in no way responsible for the duties of others. If it breaks down, the inconvenience is chiefly confined to the vehicles it is hauling, and in due course they are extricated from their difficulty by the aid of another engine.

With electricity we are locating our power at one spot in so many miles of line, and if that breaks down that section of line is practically dead. But with the usual spare parts—the duplication, if necessary, of the generating units—there should be no reason to anticipate such a failure. The same argument in a measure applies to the power at the distributing stations. Here, however, the case may be met not only by duplication, but by, in emergency, connecting one section through to its neighbour. For the time being inconvenience would be felt; speed would be reduced, but traffic would not be stopped. Of all this we have evidence in that which has already been done. We see railways being worked, tramways operated, and other large undertakings all dependent upon one large and central source for their life and being. Electric railways have become an accomplished fact, and we may turn to those that are in use as exponents of success or of difficulties to be encountered.

Does the magnitude of the question we are considering — the eventual supersession of the steam by the electric locomotive—remove it from the category of that which has so far been done? I think not. The basis is there. It is to-day in useful operation. Improvements will come. The mode of working which we see to-day may, and probably will, be simplified, but this will only strengthen that which has already been accomplished.

Still, there are points of great interest for consideration. As a rule, that which has been done has, with one or two exceptions been confined to underground lines, and these exceptions have not as a rule dealt with such heavy work as the large overland railways require to compass. Overground railways have to work through all kinds of weather—rain, snow, fog—and at times to pass over rails submerged in water. Winter floods are not unusual in certain localities of nearly all overland railways. These are conditions which will affect the construction of the locomotive, the arrangement of the current collector, and the contact-rail, and are subjects for thought not only in themselves but in relation to the mass of under-gear which now appertains to all passenger railway stock, as also to the relative position and construction of roads, their repair and renewal.

A question may here intervene whether a similar economy would attend the operation of small branch lines of railway where the trains are few and far between. Consider! Why are the trains so few and far between? The traffic is, we will say, a fixed quantity, There are only so many tons of goods and so many passengers passing over it daily. The steam locomotive is available only at certain times, and to attain economy it is necessary that so many trips only should be made. The accommodation is limited to this. But if the power for working the trains were constant, although reduced, any number of trips might be made. The additional cost would be that only of the driver, for the rest the branch would be no more costly, while the frequency of the communication would tend towards the development of the district, and the consequent increase of trade.

I have now, I believe, fairly set forth the salient features of this question. The data which I have produced speaks greatly in favour of electrical energy as a motive power for the movement of railway trains. The economies which it would apparently effect are, indeed, so large as to raise a doubt whether my deductions—whether the figures I have adopted—are fair and reasonable. It must not be forgotten that my calculations are based upon a mileage run clear of stoppages or other contingencies. Stoppages are unavoidable. They *will* arise, and provision must be made to meet them. But I find it difficult to identify them further than I have already done. Stoppages will not affect the coal bill. I have taken the present cost of drivers and firemen to apply to that for drivers and assistants for electric locomotives. My allowance for repair and renewal of machinery will, I think, be generally supported. Necessarily the subject has to some extent had to be dealt with more in the abstract than in detail, but I venture to hope my figures will not be found illiberal. We must not lose sight of the fact that the conditions are a constant load and continuous output for every hour of the year. I believe the cost of shunting at stations and in goods yards may be met by the economy attending the use of a cheaper coal than that which is necessary for the steam locomotive; but assuming that some provision should be made for this, for administration and contingencies, I conclude that 20 per cent. (say £50,000) of the accredited saving will cover it.

We thus bring the net annual advantage to approximately £208,124, and if we deduct interest on the primary outlay it will further reduce it to £191,674. Whether it is, in face of the savings to be affected in engine sheds, coal stages, water cranes, &c., fair to make a debit in full of this amount, I must leave those who are interested in the question to determine. Broadly, it appears to me to mean this: that were a new company to start with electricity as their motive power, they would not need to take into consideration the interest on the entire additional outlay, because they would save a great portion of it in other directions.

But were an established company to adopt it, they would already have incurred the cost for the lands, buildings, &c., and the expense for establishing electric working would unavoidably prove to them, for some years, an addition to their capital charges.

Although I feel that my reason for pursuing such a course will be obvious, it may be desirable that I should emphasise the fact that my sole object in availing myself of the data afforded by Mr. Johnson's presidential address to the members of the Institution of Mechanical Engineers is that I might deal with data extending over a long period of years, rather than draw a comparison with a period which might be regarded as possessing some abnormal feature. It must, however, be noted that recent figures tend to greatly magnify the result. I have shown that, with electrical working, certain economies are to be anticipated. The annual amount of these economies is based upon the ascertained saving *per train-mile*, multiplied by the average annual mileage for the 24 years —viz., 32,485,580. The mileage for 1899 is 45,453,438, and the expenditure £2,006,069, as against the 24 years' average £1,122,899; and the train-mile cost has risen to 10·59 as against 8·943d. Assuming that the saving per train-mile remained the same—it would probably be larger, consequent upon the increased cost of coal—the resultant saving would be, independent of any deductions for interest or contingencies, £364,006.

Large as is the apparent economy thus presented, it would, were it possible to employ a gas plant for so large an output, be increased by the use of the "Mond" gas system. Such a system would appear to invite consideration, at all events, for smaller installations, as, for instance, for the operation of branch lines.

Here it may be perhaps asked: What good can attend the production of these figures, or the results they advocate, seeing that the railway generally is wedded to the steam locomotive? Is it probable that any railway company will cast on one side their present equipment for the purpose of taking up that, which, although holding out fair hopes of a large economy, is yet, in a measure, or in the large measure to which it would have to be applied, mainly an untried agent? To this I reply: Railway companies are under the direction of business men—men who know the value of money. Satisfy them that economies are to be effected—and do not let us forget that the economies are not confined solely to those with which this paper has dealt, but probably to many others indirectly associated therewith—and that the economy embraces a reliable means of working, and they will not be found undesirous of testing its worth. The life of a steam locomotive is not an indefinite quantity. Its replacement by one of more modern construction or of greater power, quite apart from its ultimate destruction by wear and tear, is an appreciable fact. As traffic increases, so additions have to be made. We see so many new engines ordered year by year. What is to prevent a railway company, instead of thus perpetuating its annual costs, setting apart portion by portion of their system for operation by electrical energy, and, instead of ordering for, say that portion of their system, steam, to order electric locomotives; and thus to bring, piece by piece, their entire system under electrical operation? No sane railway management would do otherwise; and I assume that, should my figures stand unrefuted, no railway company would desire to follow any other course. Prove its economy, prove its reliability, and there is nothing in the fact that railways are, for the time being, the slave of the steam locomotive, to militate against their supersession by electrical energy.

That this paper deals with a problem which, sooner or later, will force itself upon the attention of all who are interested in railway progress, few will be disposed to dispute. So far it has been considered solely in the realm of economical working—in the interest of the railway shareholder. But are we justified in looking at it only from this standpoint? Does it not embrace a question of

still greater magnitude? Is it not one of even national interest? If, by the aid of electricity, we can save no less than 18·876 lbs. of coal per train-mile, it is clear we could save *no less than three million tons* a year* if all our railways were worked by that agency.

View it again from still another standpoint. Twenty thousand locomotives moving about throughout the land cannot fail to leave their mark behind them. Our railway stations, the telegraphs which traverse the railway routes, the trees which grow on its borders, all bear evidence of their presence.

The supersession of the steam locomotive by the electric locomotive will bring with it a purer and a more cleanly atmosphere—cleanly railway stations—cleanly railway carriages—a higher and a purer sanitary condition of life.

ELECTRICITY IN THE PRINTING OFFICE.

Mr. W. H. Tapley, in an interesting article on electricity in the printing office, which recently appeared in *Cassier's Magazine*, demonstrates that most of the operations that are carried on in a printing establishment can be very materially aided by electricity.

The printing office, in its broadest sense, includes, together with the composing and press work, that of binding, electro and stereotyping, lithographing and photo-lithographing, and in all these functions electricity is being applied with marked success. Since electric lighting and power have been developed to their present pitch of excellence, the electro-plating and typing branch has been almost neglected, and the author very properly points out that in many printing establishments the plating dynamos themselves have not been given the care in designing that all other classes of dynamo-electric machinery have received, and, as a rule, are built on patterns employed 15 or 20 years ago. There is no reason, however, why this class of machinery should be inefficient, and we are very much inclined to doubt whether plating dynamos, as now made, retain the inefficient characteristics of the machines of 20 years ago. We do know for a fact that some firms, which have earned great reputations as designers of lighting dynamos, have turned out some very excellent specimens of plating machines, which, in point of efficiency, are equal in every respect to generators designed for other classes of work.

We are quite convinced that an efficient dynamo for plating and electro-typing work would affect very considerably the cost of production. The advantages of electric lighting in a printing office are almost too obvious to need repetition; but while recognising the improvements in conditions that electricity brings in its train, we are not quite convinced that the author is quite right when he says that it is of the utmost importance that light in a composing room should be uniformly distributed, not brilliant in some places with intermediate shadows, or dimly lighted sections. First of all, adequate light must be provided at the case, and it is a matter of quite secondary importance whether the remainder of the room is merely dimly lighted. Shadows, of course, are undesirable, but if the object of introducing lighting into a printing office is to provide sufficient light for the composing work, it must usually follow that the general lighting is not uniformly distributed.

We have had some experience of inverted arc lighting, and while the system gives most satisfactory results in many places, we are not sure whether it would be altogether desirable in a printing office, for we doubt whether by this means the light at the case would be sufficiently intense. In workshops, it is true, most of the mechanical operations can be conducted by means of inverted arc lighting, and certainly the system is vastly superior to ordinary arcs, but work at the case is of a somewhat fine character, and it must be remembered that the composer is working with a very dull substance; hence we are somewhat inclined to think that a single incandescent light over the case would give better results than inverted arc lighting.

It is probable that the most important application of electricity in the printing office is found in the use of the electro-motor for driving machinery. It must not be taken for granted, however, that motors can be employed indiscriminately for printing machinery, for, on the contrary, it needs considerable skill and foresight to suitably connect the motors and the main shafts of the machines in order to give satisfactory results. We know of an instance in this country where electricity has been employed for driving a printing office, and the results have certainly not justified expectations; but we are afraid that the troubles which arose in this particular case were due to the fact that the engineer who carried out the scheme had little or no conception of the duties of a printing office. Apparently Mr. Tapley has had some experience of this, because he makes a sweeping statement to the effect that, encouraged by the first indications of success and the wide field of labour that this one industry afforded, electrical manufacturers and engineers started at this problem with the assumption that theirs was the vital and most important side, forgetting that they were only a means towards an end, and not the end itself, and losing sight almost entirely of the fact that the printers wanted printing done which should be in every way equal to that of the steam-driven printing press, with sufficient advantages to warrant the increased cost, and that the printing office did not exist principally as a market for the sale of electric motors and accessories. We consider that the best results ought to be achieved when the motor is directly connected to the press through spur gearing; driving by belt from a motor (a practice which is not uncommon in many works) is not only undesirable on the ground of taking up more space, but is probably more dangerous, and certainly noisier, than the use of a direct coupled machine where raw-hide pinions are employed. A very necessary feature in the application of electric driving to printing work is the variation of speed control, and it is hardly worth while for an electrical engineer to attempt to carry out such work unless he can provide a ready and convenient means of controlling the motor. Probably one of the most interesting applications of electricity in this country is in the case of calico printing machinery, which, while having something in common with the ordinary printing machinery, calls for nicer adjustment and more careful attention, not only because the work is of a finer quality, but the materials are a great deal more expensive than those employed in ordinary letter-press printing. Moreover, the calico printing machinery is essentially a colour machine, some printing as many as 12 colours at one time. According, therefore, to the pattern, the speed of the machine must be regulated, and in the case we have alluded to motors are applied direct to the printing machines, and a variation of some 16 speeds is obtained by the use of a three-wire system, on which it is possible to place the motors on the two outers and between an outer and a neutral wire.

According to the author, careful tests have shown that the friction load of the shafting in a printing office when driven by steam varies anywhere from 30 to 70 per cent., depending upon the number of presses in use and how they are located with reference to the main lines of shafting.

A safe estimate for most offices of ordinary size can be placed at 40 per cent., which should mean a saving of about £100 per annum, when figured on a 6 per cent. basis. This represents an investment of £1,666, which amount of money will pay for the complete electric installation for 25 printing presses using 2, 3, and 5-H.P. motors with best types of controllers, rheostats, and circuit breakers. The average cost, including attachment of motor to press, done in a most workmanlike and substantial manner, should not exceed £65 for each printing press. This is for the standard geared type of motors. A printing office of moderate size can thus afford to replace the steam fixtures with a modern individual electric equipment, for the saving in power will, as shown, more than pay for this investment on a 6 per cent. basis. One of the most important changes effected in the printing office by the introduction of electric driving is, that it is now no longer necessary to arrange the machinery in certain definite positions, as was necessary with a line shaft; and, as the writer points out, the question is merely one of having sufficient space. No doubt the ability to place machinery in almost any position ought materially to reduce the handling of material.

Such improvements must obviously affect the output of the establishment considerably without increasing the expenses. It has been found that in many offices the output can thus be increased from 10 to 20 per cent.

Apart, however, from the economy effected by the introduction of electric motors into printing offices, there are many other advantages gained under the system which are of very great importance. There is less liability, when there is no overhead shafting, of paper being spoilt by oil and dirt; and what is also of prime interest to the printing manager, the absence of overhead belting and gearing ensures that the lighting is very much improved, all of which obviously leads to a higher grade of work. In the author's opinion experience shows that a cumulative compound motor gives the most satisfactory results, the control to be by armature resistance to normal running speed, and the higher range of speeds being obtained by weakening the field of the motor, for which an external resistance with a large number of contacts should be provided and connected in series with the field circuit. In Mr. Tapley's view the controller should have six forward gradations and two for reverse; these circuits being so arranged as to cut out the series-winding when the handle is in the full-on position, leaving the motor a plain shunt motor, which can have its speed still further increased by weakening the field through the field regulator already provided. The function of the cumulative series winding is to provide a stiff starting torque for proper handling during make-ready together with the ordinary starting of the press. No doubt some such arrangement answers better than a motor having a constant field, whether the press is running or idle, and, no doubt, the plain shunt motor with its field in circuit, whether the press is in service or not, would consume more energy than when the plain cumulative winding is used, but we should hardly have thought that the difference would have been from 10 to 15 per cent. The author claims that a motor for a printing press should be wound to have its highest efficiency at about three-quarter load, experience having shown that the majority of presses operate at from 60 to 75 per cent. of the rated capacity of the motors best suitable to their use. This strikes one as being rather mixed, but is, to some extent, explained by the author's suggestion that the motor should always be large enough to start the press, no matter in what position the press bed may be. But then, one has frequently urged the adoption of direct current motors on the grounds that they are able to give for short periods very much more than their normal rated capacity, and if one has a motor, driving a printing machine, which is capable of developing for short periods 30 per cent. more than its normal capacity, it ought to come to much the same thing as the motor which is working at three-quarters full load.

Opinions are divided as to whether it is better to employ a geared or direct-connected motor in press work. Of course, if the armature is employed direct on the main shaft of the machine without the intervention of any gearing, it obviously needs a low speed motor, and it is not surprising to learn that the cost of such machines is twice that of a standard moderate speed motor. Certainly the direct-connected motor ought to run practically noiselessly, but the

* 396,241,265 train-miles × 18·876 lbs. = 3,339,040 tons.

disadvantages are, that as it is a specially made machine, there might be some difficulties in renewing parts within a reasonable period. Moreover, the geared motor has the further advantage that when it is taken from an old machine it can be applied to any other without much trouble. As regards cost of energy for the two systems, geared and connected, Mr. Tapley says that the cost for doing work, all things being equal, on sizes from 5 H.P. to 10 H.P., is about on a par. With from ½ H.P. to 3 H.P., it is favourable to the geared motor. The cost of operating printing machines by electricity is, no doubt, in most cases, less than with shafting belted, but though the author considers this a small item compared with the beneficial results derived from the individual equipment which gives independent drive and control to each press, we doubt whether these attributes would appeal so strongly to the proprietors of printing works as the fact that some distinct saving is likely to be effected to meet the cost of outlay on electric plant. Mr. Tapley's experience on the question of maintenance of motor is that the costs for repairs to printing presses have been less, and the presses out of service less on this account than before using this method. We quite agree with him, however, that only that type of motor which has been specially developed to meet the requirements of printing presses should be considered by practical printers, and the lowest first cost is frequently the most expensive in the end, as an improperly designed motor will invariably cause many stoppages, which will soon account for more than its entire first cost. Undoubtedly the accessories needed in an electrically-driven establishment are of very great importance, and the controller is a device to which special attention should be paid in a printing office. Moreover, it should be located within the easy reach of the printer or pressman, and so placed as not to interfere with the accessibility of all adjustable parts of the press. The question of individual or grouped driving is just as difficult to answer offhand in the case of a printing office as in other establishments, and we are afraid that the conditions themselves must decide whether motors should be separately applied to machines, or should, in some cases, be used for driving shafting.

THE GERMAN ELECTRICAL ENGINEERING INDUSTRY.

The Development of Business Assisted by Financial Institutions.

One of the most remarkable facts in connection with the development of electrical engineering in Europe during the past few years has been the exceedingly prominent part exercised by Teutonic firms in the promotion and completion of different enterprises throughout the German empire and in other countries in Europe and other continents. Indeed, it must be confessed that we in England almost fail to comprehend the enormous work which German companies have already carried out, are in process of undertaking, or are negotiating for both at home and abroad. It is not only the works which have been in existence for a considerable number of years that engage in foreign trade, but also those which have been established within recent years, and it is this increasing competition which in the near future will more largely assail the independence of British firms in the United Kingdom and the Colonies, and in the neutral markets of the world. It is unnecessary to labour this point, since it is now common knowledge that German companies, in addition to firms of other nations, are competing for the contracts for the conversion of the Metropolitan and District railways to electric traction; whilst it is now reported from Frankfort-on-the-Main that a local company in open international competition has obtained the contract for the steam dynamos and accessories required by the Charing Cross and City Electric Lighting Company, and representing no less than 25,000 H.P.

The fundamental principle underlying the success of German, as well as of English, firms is, of course, purely one of finance, because they would not exist without capital, but the former would appear to have the advantage of the latter in regard to the raising of money for the extension of existing or the initiation of new undertakings. If an electrical company is well established on a firm basis, and requires additional capital, it is only necessary to make application to one of the principal banking institutions or to its shareholders. The banks make a practice of assuming the responsibility for subscribing for a large block of shares, which, to some extent, are ultimately either transferred to their clients, or are placed upon the market. Thus, without incurring the risk of an appeal to the general public, the electrical company which is concerned in the matter receives cash payment for the block of shares at a fixed price of issue, which frequently includes a premium amounting, in some cases, to as much as 60 per cent. above par value. The remainder of the emission—that offered to the shareholders—is also placed at a premium, and in some cases proprietors have complained, because the opportunity has not been afforded them of subscribing for a larger number of shares. Even if receptive shareholders were willing to take up the whole of new issues, the idea prevails among some of the directors of the electrical companies that it is not desirable for them to be permitted to do so. The directors contend that it is indirectly beneficial and advantageous to the companies to be supported by the principal banking institutions, which become interested in the undertakings to a considerable extent apart from the shares disposed of to their respective clients.

It should be mentioned that besides being issued at a premium, new shares in companies having a high reputation do not begin to participate fully in the profits for some months after being created, and that explains why a full dividend is frequently paid on the larger portion of a company's ordinary capital and about half the amount of the dividend on the remainder of the capital—that is, the last raised by the company. In addition to the leading banking institutions, there are other banks or electrical investment companies—generally termed companies or banks for electrical undertakings—which take a prominent interest in electrical enterprises. These industrial banks are prepared to absorb shares in existing engineering companies of good standing, and especially in the case of new concerns promoted in Germany and in other countries. It is possible that a reference will be made on a future occasion to the activity of the industrial banks, but for the present it is only intended to deal briefly with the electrical engineering companies of the first order in Germany, which, in view of their rapid growth and international trade, deserve consideration at the hands of the industry in the United Kingdom.

The information given below has been compiled from various sources, including the official reports of the companies for the past financial year. By the past financial year is implied the last completed year of business activity, namely, 1899-1900. In some cases the official returns for that period are not yet available, whilst in others the reports for the year have only been issued recently, and it will be understood that the end of the financial year, or the period at which the report is issued, differs in the case of most companies. To the official statements has been added other information, which brings the summary up to the end of last month. Some of the official reports are exhaustive, whilst others are extremely meagre in regard to points of detail, which are withheld from the public on the ground of being of possible advantage to trade competitors. Having said so much, it only remains to be stated that notwithstanding the heavy fall which took place some time ago in the quotations for the shares of electrical engineering companies, the works of the different enterprises are, almost without exception, still well employed on profitable contracts; that as the same amount of confidence is not now being manifested in the probability of a continuation of what is termed the "high conjuncture" or period of unexampled industrial prosperity, increased vigilance is being displayed in regard to long-time contracts; and that the new customs policy, as proposed in the renewal of commercial treaties with other countries in 1902 or 1903, is being carefully watched by the German electrical companies in order that the sale of German plant in other countries may not be prejudiced by the imposition of stringent tariffs which would cause retaliation on the part of other countries.

The Siemens & Halske Company, of Berlin, which is one of the principal firms in Germany, and is now largely interested in the English house of Siemens Bros. & Co., has likewise had a prosperous career during the past few years. The shareholders received dividends at the rate of 10 per cent. for each of the years 1896, 1897, and 1898, and the distribution is not expected to be inferior for the past financial year. At the time of writing the company's report has not been issued, but the directors recently intimated that the course of business had been satisfactory, and that as far as could be ascertained, the dividend would amount to 10 per cent. The capital of the company, up to a few months ago, amounted to £2,250,000, and it was then decided to increase it by the issue of 9,500 new £50 shares, for the purpose of providing additional working capital and acquiring an interest in the English and Russian firms connected with the Siemens family. Since that time the company has issued 5,000 of the new shares to Herr Karl F. Siemens, who, in return, has transferred to the former shares in Messrs. Siemens Bros. & Co., of London, to the extent of £200,000, and shares in the Russian electro-technical works of Siemens & Halske representing the sum of 2,000,000 roubles. It appears that the Russian company in 1898 acquired the business established in St. Petersburg by Siemens & Halske many years ago; in 1897 it paid a dividend at the rate of 6½ per cent., and in 1898 5½ on a capital of 4,000,000 roubles, whilst a year ago the capital was increased to 7,000,000 roubles. The remaining 4,500 new shares of the Siemens and Halske Company, of Berlin, have recently been offered for public subscription at a premium of 55 per cent. Apart from the share capital the company has raised loans aggregating £1,500,000, of which £1,000,000 in 4 per cent. bonds was issued in 1898 and £500,000 in 4½ per cent. bonds in the present year. As a further development it is stated to be the company's intention to establish large new works for the construction of dynamos, and an iron foundry, which would provide employment for 6,000 workmen. The works would be built at the Nonnendamm, on the Lower Spree, where the company's cable factory and brass foundry are already in operation. [Since this was written the directors have decided to recommend a 10 per cent. dividend for the past year.]

The Allgemeine Elektricitäts Gesellschaft, of Berlin, which is one of the leading firms in Germany, and is represented in this country by the Electrical Company, has been remarkably successful during the past few years, as is evidenced by the fact that the business operations have resulted in a steady maintenance of the payment of what may be regarded as high dividends to the shareholders. This will be understood when it is mentioned that in 1895 the distribution on the ordinary share capital of £1,250,000 amounted to 13 per cent.; in each of the years 1896, 1897 and 1898 dividends at the rate of 15 per cent. were paid, whilst for the past year the return proposed to the shareholders is also 15 per cent. on £2,350,000, and 7½ per cent. on £650,000 out of the total capital of £3,000,000. It appears to be the company's practice to lump together in one sum the gross profits earned in the various departments of its business, so that it is impossible for trade competitors to ascertain which particular branches yield the most satisfactory results. For instance, the gross profits in 1897

amounted to £406,120, in 1898 to £559,753, and in 1899 to £615,721, whilst the net profits were respectively £342,657, £499,962, and £535,761. These results have been arrived at after making what is considered to be ample provision for depreciation and contributions to the reserve fund. In addition to the share capital of £3,000,000, the company has already issued bonds amounting to £700,000, and a further instalment of £750,000 has now been raised at the rate of 4½ per cent. for the purpose of providing for extensions of the Berlin electricity works. The gross turnover for the past financial year reached £38,600,000, but this enormous sum would be misleading were it not mentioned that it represents both sales effected on account of manufacturing operations and those instances where the company has acted as a contractor, and has only been the intermediary for the supply of machinery and plant. The report of the directors states that 16,418 dynamos of 208,200 H.P. were constructed during the past financial year, as compared with 11,438 of 197,689 H.P. in the previous 12 months. In this connection it is to be noted that the rotary current plant is being more and more utilised for power installations.

(*To be concluded.*)

THE PARIS EXPOSITION OF 1900.*

By CARL HERING.

(*Continued from page* 927.)

The high voltage direct current series system for power transmission and very limited distribution, made another and probably unsuccessful appeal for recognition, in the form of an exhibit by its indefatigable champion, Mr. Thury.

The large engines exhibited were, as a rule, slow speed, which is the prevailing practice on the Continent. The very high speed steam turbines are also meeting with favour.

Among the various types of motors, the most interesting was the three-phase induction or Tesla type, which seems now to have demonstrated its superiority over all the others except perhaps the continuous current motor, upon whose field it is, however, encroaching very decidedly, with the present prospect of becoming its equal in importance. The largest company in Germany, and perhaps in the world, estimates that its sale of three-phase induction motors will before long exceed that of its continuous current motors. Its very large factory, including even the rolling mill, is equipped with these induction motors mostly direct connected. There is a single textile factory in Switzerland in which 500 of these motors are used for direct driving. The induction motors, almost exclusively of the three-phase and not two-phase type, are being introduced very largely now, especially in Germany and Switzerland.

A nearly uniform type seems to have been adopted by most of the makers. In this, the primary circuit is the stationary one, and is distributed over the surface like a drum winding, as distinguished from the coils used in the earlier forms of Tesla. It is this distributed winding which is the chief improvement that has made them such a success; it seems to have been first introduced by Dobrowolsky in Berlin. The larger ones are almost always started with a resistance in the secondary external to the motor; in some cases a short-circuiting device is provided on the rotor for use after starting, so that the brushes may be raised while running, to prevent wear. It will be noticed that in some respects this nearly universal practice abroad differs from that in this country, where even very large motors up to 800 H.P. if not more, are made without any brushes, being started with a transformed current at lower voltage; others are made with the starting resistances on the rotor itself, which also dispenses with brushes.

Among the few other devices exhibited for starting such motors, the object of all of which is the avoidance of slide rings, may be mentioned the ingenious one of Fischer-Hinnen, who uses an inductive resistance of very low ohmic resistance, in parallel with a non-inductive one of high ohmic resistance; together they act like a high ohmic resistance when the motor starts, owing to the high frequency of the secondary currents, and diminish automatically as the motor increases in speed, because the frequency of the secondary then diminishes; they are permanently connected to the rotor. In the Deri motor the number of poles is changed by a switch in the primary, and the resistances are permanently connected between points of the secondary which have a difference of potential for one number of poles, but are of the same potential for a different number of poles; they are therefore either in or out of circuit and admit of no gradation, which is a disadvantage. Boucherot uses practically a double motor, the field of one of which may be mechanically turned through a certain angle for starting: the two secondaries are permanently short-circuited in series with each other, but have resistances connected between the coils through which the secondary current is forced to pass when one of the fields is displaced, but only then; it seems like a rather complicated device as compared with the simpler slide rings which it replaces.

For the A.E.G. induction motors, Dobrowolsky claims that they will stand a 200 per cent. overload, have a power factor of over 0·9, and still give the normal output for two-thirds the normal voltage.

Induction motors are built on the Continent for high voltages up to 6,000 and I believe even 10,000, thus saving the transformers for all but higher voltages than these.

As to single-phase induction or non-synchronous motors, it looked as though most of their makers thought it best not to exhibit them, or to evade questions asked about them. Among the exceptions may be mentioned the Brown and the Oerlikon motors, both of which start with an auxiliary winding. Brown, who constructs them up to 100 H.P., states that they start with ½ to ¼ full load torque at about normal full load current. He has even made them for starting with full load torque at about double normal current. The air-gaps are very small, from 1 to 1½ mm. A cheap liquid condenser made of iron plates in soda solution, is used for producing the artificial starting phase. The Oerlikon motors are claimed to start with ½ normal torque requiring 80 per cent. normal current, and to stand an overload of 50 per cent. An impedance coil is used for starting.

A very interesting installation of single-phase motors, and quite a unique one, exists in Frankfort o. M., Germany, where about 500 such motors, mostly by Brown, are connected to the large single-phase alternating current plant, the motor load of which has levelled the load curve very decidedly. They vary in size up to 100 H.P. and are used even for elevator work. They appear to be satisfactory to the users, even though they must always be started unloaded. This is probably the largest motor plant of its kind and shows what can be done even with single-phase motors.

One of the applications of three-phase induction motors which is of special interest, and which seems to have a promising future, is to traction. This three-phase traction system, which is scarcely known in this country, is in regular and apparently very successful use on a number of lines in Switzerland, where it is being introduced by such well known constructors as Brown, Boveri & Co., and the Oerlikon Company. A few of these roads were visited by the writer, and as far as could be learned they were running very satisfactorily. The double trolley wire, which is essential, and which has often been urged as being such a serious objection, does not seem to give any trouble at all; each locomotive or car had even two contacts with each wire. Many of the alleged objections are overcome by the use of the contact bar instead of the trolley wheel, which completely avoids any jumping off of the pole, and greatly simplifies the overhead wiring at the switches, which is in fact not complicated at all. The motors are started with resistances in the secondary as usual. There is no complicated controller, as the two motors are always in parallel. The train starts well and without difficulty, and it seems, without any very abnormal current. The chief objection to the system seems to be that the running speed is always the same, in which respect it is like a cable road; it is therefore not possible to make up lost time except on a down hill coast, while on steep up grades there is a considerable demand for power as the speed is always the same maximum. No system of efficient speed regulation is used, presumably because none has been found to be satisfactory. This seems to be the real and serious objection to the use of the system in this country, where high speed seems to be an essential requirement. One of the freight locomotives was provided with a purely mechanical device for halving the normal speed, but no other information could be obtained than that it was then in the repair shop.

On that bold enterprise, the Jungfrau Bahn, which will ascend one of the highest snow peaks in Europe, a very ingenious and apparently novel device is used on one of the Oerlikon three-phase locomotives, in order to enable a train to descend to a habitable region even if connection with the power house is broken or if something should happen to the trolley wires or poles. Ordinarily in descending, the induction motors act as generators, sending their current back into the line, which therefore must be intact. The device referred to, consists of a small direct current generator driven by the decending locomotive, the current from which is led into one branch of the star or Y-connected primary and out at the other two ends in multiple; this excites the motor and it then generates alternating currents in the secondary which are dissipated in the resistances used for starting; it thus operates as an electric brake without being in contact with the line.

While three-phase traction in its present state would probably not be practicable here for cities, there seems to be a field for it on long distance interurban lines with few stops, as it is much cheaper. The estimates for the Jungfrau Bahn showed that the first cost would have been 50 per cent. greater if the continuous current had been used on the locomotives, as is done in this country.

Returning to the subject of alternating current generators and motors in general, there is a characteristic difference between European practice and that in this country which seems worth mentioning. Here the coils are usually form-wound and then laid into open slots; there the wires are more generally threaded through completely closed holes as in the Oerlikon and Brown machines, or through holes of which the webs have been cut through with a very thin saw cut, as in the Dobrowolsky machines of the A.E.G. Mr. Brown gives the following reasons for his preference:—Lower magnetic resistance, smooth surface of core, seamless tube insulation, solid poles, ease in parallel running and avoidance of wedges, binding wire, &c.; his experience is, that it takes as long to replace a form-wound coil as to thread in a new one in place. Dr. Behn-Eschenburg, the engineer of the Oerlikon Company, gives his reasons as follows:—The smoothness of the surfaces enables the air-gap to be made as small as 0·001 of the diameter in induction motors, which is hardly possible with teeth; with a web over the hole of only 0·1 mm. the coefficient of magnetic straying can be reduced to 0·04, and a maximum power factor as high as 0·92 can be obtained; the maximum torque will corre-

* Inaugural address by the President at the 147th meeting of the American Institute of Electrical Engineers, New York, October 24th, 1900.

spend with 3·5 times normal current, and the possible overload can be 2·5 times the normal; if the holes were changed into teeth, all else remaining the same, the magnetisation current would be at least doubled, the straying coefficient reduced to about 0·03, and the best current for the resulting maximum power factor of 0·94 would then be more than doubled and the copper conductors therefore increased, or for the same load the power factor reduced to 0·91; the slotted armature would have to be made longer axially if it is to have the same current at no load as the one with holes; moreover, seamless insulation tubes of micanite can be used in the holes, which if 1 mm. thick will be quite safe for 3,000 volts. However, he quite impartially recognises the favourable features of slots with form-wound coils, and admits that they may outweigh the others if a factory is suitably equipped for such work; he believes that under certain circumstances the one, and under others the other, is the better.

Another interesting characteristic difference between American and Continental practice is that here synchronous converters combined with transformers are more generally used for transforming high voltage three-phase currents into low voltage direct currents, while on the Continent dynamos driven by high voltage induction or synchronous motors are the rule. Although the favourable features of each are well understood, the reasons given by such a successful constructor as Brown for preferring motor-generators may, nevertheless, be of interest here. He states that they can be regulated with ease and precision; no transformers; both parts can be better designed without making concessions; no hunting; ease in starting; no depolarisation possible; secondary voltage absolutely independent of the primary. He admits that the synchronous converter is cheaper and more efficient, but claims that the differences are but slight; he has obtained 90 per cent. combined efficiency for a 250-KW. motor-generator set.

The difficulty of not being able to regulate the voltage of a synchronous converter is overcome by Dobrowolsky in a very ingenious and apparently successful way. Instead of passing the continuous current through a booster, which would require an expensive machine, and generally with a very large commutator, he passes the alternating current through an alternating current booster on the same shaft; this is separately excited with a continuous current, and therefore permits of regulation. The one shown to me would raise or lower the voltage 25 per cent., making a range of adjustment of 50 per cent. It either drives or is driven by the converter. Although this overcomes one of the chief objections to synchronous converters, he has not changed his preference for motor-generators.

Another modification of interest used by this same engineer and others is that six-phase instead of three-phase currents are led into the synchronous converter, the advantage being that its output is thereby increased, according to a French constructor, about 45 per cent. The attending disadvantage of six slide rings instead of three is said to be more than balanced. The general use of three-core transformers for three-phase currents instead of a single one for each phase, as is customary here, is another instance of a difference in practice.

It was of some interest to note the almost complete disappearance of the Gramme ring armature among generators and motors, and the use of multipolar fields for smaller sizes than formerly, especially with motors. The Dobrowolsky system, hardly known here, of supplying three-wire circuits from a single generator by connecting the neutral through induction coils and slide rings to two opposite parts of the armature winding, seems to be meeting with favour on the Continent.

A criticism of American motors made by a prominent German manufacturer who has bought and tested many, was that an American horse-power was only three-quarters of a real horse-power.

In electric railroading there seemed to be comparatively little of special interest to Americans, besides the three-phase motor system and the contact bar, already referred to, both of which deserve more attention here than they are getting. The new Metropolitan underground electric road, quite recently opened in Paris, is apparently an excellently constructed but wretchedly managed road. American management would diminish the total time of transit and increase the profits greatly. It is an improvement over the new underground road in London, in that motor cars are used instead of locomotives, but, being directly under the street instead of very deep, as in London, the excellent device of a descending and an ascending grade between stations, to aid acceleration and stopping, cannot be taken advantage of. Both of these roads use American electric machinery.

(To be continued.)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1900.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

21,338. "An improved illuminated advertising device for attachment to incandescent electric lamps and the like." L. Connor. Dated November 26th.

21,366. "An improved method of and means for joining the ends of lengths of telegraph wires and other wires." R. J. Fawcett. Dated November 26th.

21,374. "Improvements relating to electric incandescent lamps." H. H. Lake. (The firm Electrische Gluhlamper Fabrik "Watt" Scharf & Company, Austria.) Dated November 26th.

21,399. "Improvements in variable resistance electric contacts." F. G Sharp. Dated November 26th.

21,409. "Improvements in conduits for electrical conductors." S. B. Donkin. Dated November 27th.

21,447. "Improvements in electric railways." The British Thomson-Houston Company, Limited. (G. T. Woods, United States.) Dated November 27th. (Complete.)

21,448. "Improvements in systems of electrical distribution." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated November 27th. (Complete.)

21,449. "Improvements in interrupting devices for electric circuits." The British Thomson-Houston Company, Limited. (E. W. Rice, jun., United States.) Dated November 27th. (Complete.)

21,450. "Improvements in methods of transforming alternating electric currents." The British Thomson-Houston Company, Limited. (J. E. Woodbridge, United States.) Dated November 27th. (Complete.)

21,457. "Improvements in telephony and telegraphy." S. G. Brown. Dated November 27th.

21,459. "Improvements in safety cut-outs for electric circuits." J. Sachs. Dated November 27th. (Complete.)

21,460. "Improvements in lightning arresters for safety cut-outs for electric circuits." J. Sachs. Dated November 27th. (Complete.)

21,478. "Improvements in or relating to electric meters." J. H. Barker and J. A. Ewing. Dated November 27th.

21,486. "An improved appliance suitable for removing screw-threaded clamping rings from electric incandescent lampholders." H. F. Cotton, A. T. Cotton, and A. H. Reddell. Dated November 27th. (Complete.)

21,490. "Improvements relating to switches for use in electric circuits." R. Lehnhoff. Dated November 27th.

21,497. "Improvements relating to an electrolytic process and apparatus for the treatment of metalliferous ores and substances for the extraction of precious metals therefrom." G. Harrison. (A. C. Lorenz, United States.) Dated November 28th.

21,501. "Improvements in electrical switches." A. Watson. Dated November 28th.

21,517. "Improvements in electric belts." O. Reinicke. Dated November 28th.

21,533. "Improvements in electrolytical apparatus." J. Matthews and W. Davies. Dated November 28th.

21,538. "Improvements in or relating to plates for electric batteries or the like." A. J. Boult. (W. J. Jackson, United States.) Dated November 28th. (Complete.)

21,540. "Improvements in or relating to overhead trolley wires or conductors for electric traction, overhead, electric cables, or the like." A. W. Hancock, J. Leighton and R. Hacking. Dated November 28th.

21,547. "Improvements in the manufacture of wire strips and the like by electro-deposition." R. D. Sanders. Dated November 28th.

21,566. "Improvements in accumulators or secondary batteries." C. A. von Welsbach. Dated November 28th.

21,575. "Improvements in electric telegraphs." A. Muirhead. Dated November 28th.

21,578. "Enclosed switch and cut-out combined." W. J. Fryer. Dated November 29th.

21,585. "An improved life guard for electric cars or other motor vehicle." A. Hudson. Dated November 29th.

21,615. "Improvements in the socket joints of metallic telegraph and like poles." E. H. Chambers. Dated November 29th.

21,617. "Improvements in electrical fuse distribution or switchboards." C. E. Zimdars. Dated November 29th.

21,629. "Improvements in and connected with means for the conversion of electrical energy derived from a source of direct current into varying or alternating currents." W. D. B. Duddell. Dated November 29th.

21,642. "Improvements relating to electric fuses." J. C. A. Ward. Dated November 29th. (Complete.)

21,644. "Improvements in systems of electrical distribution." H. B. Kent. (Date applied for under Patents, &c., Act, Sec. 103, May 1st, 1900, being date of application in United States.) Dated November 29th.

21,645. "Improvements in and relating to electric switches." Clarke, Chapman & Co., Limited, and A. L. Forster. Dated November 29th. (Complete.)

21,660. "Duplex spring holder for electric globes and shades." G. H. Ide. Dated November 30th.

21,669. "An improved reflector for electric or other lights." S. Hall. Dated November 30th.

21,674. "Improvements in the method of supporting electric motors directly connected to the axles of cars or locomotives for electric railways or tramways." J. Campbell, A. Hird, and A. B. Blackburn. Dated November 30th.

21,700. "Improvements in telephony." L. Sterne. (S. B. Fowler, United States.) Dated November 30th. (Complete.)

21,701. "Improvements in telephony." L. Sterne. (S. B. Fowler, United States.) Dated November 30th. (Complete.)

21,702. "Improvements in operating dynamo-electric machines." The British Thomson-Houston Company, Limited. (W. Le R. Emmet, United States.) Dated November 30th. (Complete.)

21,703. "Improvements in systems of electrical distribution." The British Thomson-Houston Company, Limited. (R. Fleming, United States.) Dated November 30th. (Complete.)

21,704. "Improvements in systems of electrical distribution." The British Thomson-Houston Company, Limited. (E. J. Berg, United States.) Dated November 30th. (Complete.)

21,716. "Improvements in and in the arrangement and construction of arc lamps." C. Oliver. Dated November 30th.

21,722. "Improvements in or relating to trolley wire and other conductors for electric traction." G. E. Heyl-Dia. Dated November 30th.

21,732. "Method of automatically cutting out main conductors of powerful electrical currents." Siemens Bros. & Co., Limited. (Siemens & Halske, Actien Gesellschaft, Germany.) Dated November 30th. (Complete.)

21,736. "Improvements in apparatus for electrically lighting railway trains." A. B. Gill. Dated November 30th.

21,740. "Improvements in dynamo-electric machines." W. Langdon-Davies and A. Soames. Dated November 30th.

21,759. "An improved process for the electro-deposition of metals." S. Cowper-Coles. Dated December 1st.

21,804. "Improvements in the manufacture of electrical insulating materials." E. A. Claremont. Dated December 1st.

21,806. "Improvements in or relating to trolleys, switches, and crossings used in connection with overhead wires for electric traction." P. McCullough. Dated December 1st.

21,812. "Improvements in and relating to electric arc lamps." D. W. Emerick. Dated December 1st. (Complete.)

21,815. "Improvements in and relating to armatures and inductors." V. I. Feeny. (Allgemeine Elektricitats Gesellschaft, Germany.) Dated December 1st. (Complete.)

21,837. "Improvements relating to electric incandescent lamps and the like." Societa Edison Perla Fabricazione Delle Lampade Eng. (C. Clerici & Co.) Dated December 1st. (Date applied for under patents, &c., Act, 1883, Sec. 103, June 16th, 1900, being date of application in Italy.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

517. "Improvements in type-printing telegraph apparatus." C. D. Abel. (Siemens and Halske, Aktien-Gesellschaft.) Dated January 9th, 1899. Relates to apparatus available both as transmitter and receiver in printing-telegraphy. The apparatus is shown diagrammatically, and is too complicated for abridgment. 4 claims.

537. "Improvements in press regulating apparatus for electric mains used chiefly in connection with storage batteries." J. S. Highfield. Dated January 10th, 1899. Relates to means for maintaining a constant difference of potential in the mains supplied from a variable source. A booster is so arranged as to raise or lower the pressure automatically, and when desired, to utilise excess pressure in charging storage batteries. Three armatures are mounted on the same shaft. The first armature is a motor-armature driving the shaft at the desired speed. The second armature is an exciter for generating a current in the field coil of the third generator or booster. The exciter generates an electromotive force opposed to the supply, hence the field coil is excited by a differential current, and the armature generates, opposes or aids the supply. 1 claim.

1,826. "Improvements in electric switches and cut-outs." H. B. Cutter. Dated January 22nd, 1899. Relates to a combined resistance switch and magnetic cut-out. The cut-out cannot be re-set until the switch arm is in a certain position, that is, with the resistances in the circuit. The current flows from one generator terminal through one arm of the circuit breaker and solenoid to a post. The post is connected through the other arm to the hub of a resistance switch. This is also connected to a contact and through a solenoid which forms the underload coil to the post. The circuit breaker is of the type described in Specification No. 23,260, A.D. 1897, and operates with over or under-load. When the circuit is closed, a piston is forced back and compresses a spring. On the circuit being broken under the action of the solenoids, the spring helps to break the contact and the piston springs forward, its rear end passing the lever working in the slot. This falls and prevents the piston from being pushed back until the switch arm has been brought back, when a projection strikes the pin and lifts the end out of the way of the rod. 4 claims.

2,218. "An electric switch." M. Schmidt. Dated June 31st, 1899. Relates to an electric switch for use in damp places. Consists in the arrangement of a switching apparatus in a casing capable of being made air tight, the conducting wires being inserted through openings which can be filled in. A plate inside the casing in the middle with a stuffing box for impermeably closing the switch apparatus. 3 claims.

5,208. "Improvements in the manufacture of porous diaphragms for electrolytic apparatus." T. J. Holland and A. P. Laurie. Dated March 9th, 1899. A volatile material which is insoluble in water, such as naphthalene, is mixed with the cement and the cement moulded. The substance is then volatilized. 1 claim.

8,963. "Improvements in the production of a filling paste or active material for the plates of secondary batteries." C. F. P. Stendebach and H. M. F. Reitz. Dated April 28th, 1899. Consists of an active material made of lead containing hydrogen but very little, if any, oxygen. 1 claim.

9,349. "Improved electro-magnet tooth-stopping hammer." C. Ostmann. Dated May 3rd, 1899. Consist of electro-magnet hammer for use in stopping teeth, characterised by two soft iron cylinder arrived behind each other within a casing or the like which attract and repel each other under the action of an electric current and spring whereby the continuance of the hammering can be regulated according to desire. The casing is cylindrical with conical head and forms a handle. 3 claims.

9,672. "Improvements in electric switches." J. E. Spagnoletti and J. Crookes. Dated May 8th, 1899. Consists of a base having inclined or cam surfaces a central pivot and a contact bar or lever mounted thereon, said lever being provided with contact strips or brushes, a spring on said central pivot or pin and contact terminals on the switch base. 1 claim.

11,717. "Improvements in electric batteries." A. E. Hodgson. Dated June 6th, 1899. Relates to improvements in the manufacture of electric battery and consists in the use, in combination with the accumulator plate, of such a battery, of separator plates made of glass woven fabric. 2 claims.

11,885. "Improvements in controlling apparatus suitable for use with electric motors." H. J. Walker. Dated June 7th, 1899. Consists of an electric motor controlling apparatus arranged so that upon an excessive load being put upon the electric motor connected therewith so as to reduce or stop the rotation of the motor arm and thereby reduce its back E.M.F. below a predetermined amount, or entirely remove such back E.M.F., a resistance will be automatically inserted in the armature circuit, and prevent undue increase of the current flowing through the armature winding. 4 claims.

12,693. "Improvements in registering mechanism for electricity meters." E. Borgmann. Dated June 17th, 1899. Consists of a device for counting the difference in the run of two clock or wheel works serving in electricity meters as a measurement of the quantity of current used, said device being so made that by suitable parts of both clockworks running in the same direction and sliding one upon the other each time the one clock has out-distanced the other by a certain amount, for instance, equivalent to a unit of consumption, the closing of an electrical current circuit or the action of mechanical means causes the advance of a counter by one unit. 2 claims.

13,328. "Improvements in electric coin-freed apparatus for delivering and stamping tickets." J. H. F. Krull. Dated June 27th, 1899. Relates to apparatus in which the delivery of the article takes place owing to the oscillatory motion of an armature pivotally mounted within the influence of two electro-magnets, the electric circuit being completed in such a manner that the electric current flows through the armature always in one direction and the electro-magnets in two directions alternately for the purpose of attracting and repelling the armature. This reversal of the current takes place as the coin operates two electric relays in suitable auxiliary circuits. 10 claims.

13,614. "Electro-magnetic compensating devices for power steering mechanism." J. D. Williamson, jun. Dated June 30th 1899. Consists of power steering apparatus in which are combined a transmitting cylinder having a piston operated by the steering wheel, a controlling cylinder having a piston governing the operation of the rudder moving devices, means whereby movement of the piston in the transmitting cylinder is caused to impart movement to the piston in the controlling electro-magnetically operated mechanism, whereby movement is allowed in the transmiting cylinder without corresponding movement in controlling cylinder and connections, whereby the electro-magnetic devices are rendered operative by want of correlation in the positions of the two pistons. 7 claims.

13,804. "Improvements in and connected with electric motors." P. M. Justice. (The Emerson Electric Manufacturing Company, United States.) Dated July 4th 1899. The essential feature of this present invention resides in the arrangement of a friction disc or clutch on the shaft to be driven, with which co-operates a friction disc or clutch driven by the armature shaft; another feature resides in the novel means employed for laterally displacing the armature, its shaft and associate parts, whereby the friction disc carried by the armature shaft is thrown into engagement with its companion or the shaft to be driven, another feature resides in the novel means of disengaging the friction discs, which consists in moving the armature, its shaft and associate parts laterally when the armature shaft is released, by the magnetism of the field magnets. 10 claims.

13,826. "Elastic or permeable electrodes for storage batteries." L. Tobiansky. Dated July 4th, 1899. Consists of a support made from an elastic or extensible tissue web or texture which is not attacked by the electrolyte in combination with an active mass of great permeability, by adding to the pap of lead oxides certain materials or productions of vegetable origin which are washed out of the mass by the electro-chemical action, or converted into spongy cellulose or charcoal. 4 claims.

13,955. "Improvements in apparatus or devices for giving electrical time alarms." W. Hansmann and H. Ritter. Dated July 6th, 1899. Relates to apparatus by means of which signals can be given in several places simultaneously at any predetermined period. Consists essentially of a clock, two switch or contact tables connected respectively to the clock and to the rooms where the alarm is to be sounded, a battery, bells, or other alarm instruments and plugs or similar contacts for joining the two contact tables together. 3 claims.

13,980. "Improvements in apparatus for the electrical working of railway points and signals." Siemens Bros. & Co., Ltd. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated July 6th, 1899. Consists of apparatus for the title in which the disconnection of the lead for the rotation of the motor in one direction and the connecting up of the lead for its rotation in the other direction are effected simultaneously the motor being short-circuited at the end of the movement. 2 claims.

13,981. "Improvements in energy meters for alternating currents." Siemens Bros. & Co., Ltd. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated July 6th, 1899. Relates to an arrangement that not only allows of the accurate adjustment of the extent of the pressure field in a meter acting on the Ferraris system, but also that of the desired phase shift of 90° almost independently of the adjustment of the pressure field. The pressure coils are included in two opposite sides of a Wheatstone's bridge, the other two sides, and diagonal of which are formed by resistances as free as possible from induction while an inductance coil is included in front of the bridge. 1 claim.

14,293. "Improvements in electric lighting system for stage effects." A. W. Berresford. Dated July 11th, 1899. In obtaining the lighting effects used on the stage it is necessary to mix the various colours of light and to obtain gradual changes. This is accomplished by introducing a gradually increasing or decreasing resistance into the lamp circuit and thus controlling the current supplied. In the invention this is done more expeditiously than before as the required changes are done without dismantling any of the apparatus. 7 claims.

14,300. "Improvements in primary batteries." W. C. Callmann. Dated July 11th, 1899. Consists of a primary battery in which the exciting material for the exciting solution is supported between the superposed electrodes and out of contact therewith to be acted on and decomposed by the electric current. The supporting plate is placed on the top of the negative plate. 2 claims.

14,338. "An improvement in dynamo and other magnet coils." H. A. Earle. Dated July 11th, 1899. To wind a magnet with two coils giving the same polarity, the innermost convolutions of each of the two windings are connected by a conducting piece by which the plane of the one winding is at the side of the plane of the other winding. 1 claim.

14,401. "Invisible adjusting apparatus for electroliers and gaseliers and the like." M. Weidlich. Dated July 12th, 1899. The sliding tubes are still retained. A spring tends to pull the electrolier up, but by pins and hotches it can be held down. The contacts are made in various manners. 1 claim.

14,547. "Improvements in electrical signalling system." E. Davis. Dated July 14th, 1899. (Date under Patents, &c., Act 1883, Sec. 103, December 16th, 1898, being date of application in United States.) Consists of a combination of transmitting apparatus adapted to transmit a number of signals of differing characteristics, a receiver adapted to receive said signals, and alarm, and an alarm circuit controlling apparatus in part controlled by the receiver and in part controlled by the transmitting apparatus, these parts being relatively adjustable to permit the sounding of the alarm for any of said signals, while excluding others, at the will of the receiving attendant. 11 claims.

14,583. "Improvements in hand vice and other strainers or stretchers for telegraph, telephone and other wires." W. S. Mackie. Dated July 15th, 1899. The characteristic of this invention is the worm winding gear, in which the worm wheel is secured to the drum spindle whilst the worm is pivotally secured to the strainer in such a manner that it can, when desired, be moved into gear with the worm wheel, and held securely in that position or be moved out of gear therewith. 2 claims.

14,774. "Improvements in or relating to submarine electric arc lamps." F. G. Hall, jun., and I. E. B. Dated July 18th 1899. Consists of a water-tight and pressure proof enclosing case wherein an arc of high candle-power may be produced at considerable depths under water, said case comprising a glass globe enclosing the arc a metallic case enclosing and supporting the lamp mechanism, a water-tight coupling between the two, also a water-tight passage between the two for the upper carbon, and a current conductor to the lower carbon, and a water-tight packing box through which the current conductors enter the mechanism chamber. 4 claims.

14,789. "Improvements in electrical locking apparatus for railway signals." G. H. Jolls. Dated July 18th, 1899. Relates to electrically locking apparatus which can be conveniently fixed on a railway signal post and is so arranged that the ordinary signal pull cannot lower the semaphore from its danger position unless an electrical current be transmitting to the apparatus or according to modification the pull can always lower the signal except when a current is transmitted to the apparatus. 2 claims.

14,794. "Improvements in and relating to storage batteries." S. Y. Hoobner Dated July 18th, 1899. Consists of a storage battery having a series of superposed nested upward and outward flaring hard rubber or non-conducting cells, each cell having a horizontal bottom wall in combination with a negative electrode having a series of horizontally projecting arms, said positive arms and negative arms being disposed in the same horizontal planes, and lying between the bottom wall of one cell below. 7 claims.

14,877. "Sound-proof telephone cabinet." H. P. J. Wulff and J. H. Blunck. Dated July 19th, 1899. Consists of a sound-proof telephone cabinet capable of being taken to pieces, the walls of which are padded with shoddy, and in which the hook for the reception of the receiver used as a switch, switches on an electric light. 1 claim.

15,147. "Electrical apparatus for indicating the names of stations in railway and tramway vehicles." Siemens Bros. & Co., Ltd. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated July 22nd, 1899. Consists of automatic apparatus for indicating stations on railway or tramway vehicles wherein a disc carrying a series of contact pins and a contact arm, receives a slow differential motion from a wheel running on the track so that the arm comes successively in contact with the said pins, whose distance apart is proportionate to the distance apart of the stations, an electric current being conveyed to the armature through a make-and-break contact so that at each contact of the armature with a pin a current is passed into the pin disc whence it is conveyed to apparatus for revolving the apparatus which holds the cards with the names of the state. 3 claims.

15,189. "Improvements in rail bonds for electric railways." F. H. Daneils. Dated July 24th, 1899. (Date applied for under Patents, &c., Act, 1883, Sec. 103, April 25th, 1899, United States.) Consists in leaving out of the bond several of the centre strands so that no injury is done to the bond when flattened. 2 claims.

15,203. "Improved electric elevated railway." L. J. Bruns and H. R. Otteson. Dated July 24th, 1899. Relates to an overhead railway with three rails, the carriages have somewhat the shape of an inverted U so that they can ride on the centre rail, which is placed above the other two arms of the U have on their lower inner ends wheels adapted to engage with the lower rails, and the rails can be used at the same time for conducting the current, and for bearing or guiding carriages. 4 claims.

15,460. "A new or improved tap switch for electric incandescence lamps." G. Gardner. Dated July 27th, 1899. Consists of a block in one pieces, and a box or casing of insulating material, switch bars, spring terminals, and spring contacts, the whole combined and arranged to secure a perfect break and insulation of the parts. 4 claims.

16,350. "A magnetic needle threader." M. Molitar and F. Kern. Dated August 11th, 1899. Consists of a combination of a horse-shoe magnet, pole shoes, a brass wedge, a funnel-shaped passage, and a catch. 1 claim.